REPORT

BASIS OF DESIGN REPORT
JORGENSEN FORGE EARLY ACTION AREA

Prepared for
U.S. Environmental Protection Agency, Region 10

On Behalf of
Earle M. Jorgensen Company and
Jorgensen Forge Corporation

Prepared by
Anchor QEA, LLC

August 2013

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JORGENSEN FORGE EARLY ACTION AREA

Prepared for

U.S. Environmental Protection Agency
Region 10
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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ACES	Automated Coastal Engineering System
Action Memo	Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington
AO	Agreed Order
AOC	Administrative Settlement Agreement and Order on Consent
APE	Area of Potential Effects
ARAR	Applicable or Relevant and Appropriate Requirement
BA	Biological Assessment
bgs	below ground surface
BiOps	Biological Opinions
BMP	best management practice
BODR	Basis of Design Report
Boeing	The Boeing Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CMP	corrugated metal pipes
COC	chemical of concern
COI	chemical of interest
CQAO	Construction Quality Assurance Officer
CQAP	Construction Quality Assurance Plan
CSM	conceptual site model
CSO	combined sewer overflow
CWA	Clean Water Act
cy	cubic yard
DCE	dichloroethene
DMU	dredge management unit
DO	dissolved oxygen

DOC	depth of contamination
DSOA	Duwamish Sediment Other Area
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EE/CA	Engineering Evaluation/Cost Analysis
EMJ	Earle M. Jorgensen Company
EM	Engineering Manual
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
Facility	Jorgensen Forge facility
FIS	Flood Insurance Study
fps	Feet per second
GAC	granular activated carbon
HDPE	high-density polyethylene
H:V	horizontal to vertical
HVOC	halogenated volatile organic compounds
Jorgensen Forge	Jorgensen Forge Corporation
LAET	lowest apparent effects threshold
Lafarge	Lafarge North America
LDW	Lower Duwamish Waterway
LNAPL	light non-aqueous phase liquid
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/kg-OC	milligrams per kilogram of organic carbon normalized
MHHW	mean higher high water
MLLW	mean lower low water
mm	millimeter
MOU	Memorandum of Understanding
MSS	Marine Sampling Services
MTCA	Modeled Toxics Control Act
NCP	National Contingency Plan
NMFS	National Marine Fisheries Service

NRHP	National Register of Historic Places
NPDES	National Pollutant Discharge Elimination Study
NTCRA	non-time-critical removal action
NTU	nephelometric turbidity units
OMMP	Operations, Monitoring, and Maintenance Plan
Owner	EMJ and Jorgensen Forge
PCB	polychlorinated biphenyl
Permit	Industrial Stormwater General Permit
psf	per square feet
RAB	removal action boundary
RAO	removal action objectives
RAWP	Removal Action Work Plan
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RM	river mile
ROD	Record of Decision
RTK	Real Time Kinetic
RvAL	removal action level
SCER	Source Control Evaluation Report
SHPO	State Historic Preservation Officer
SIA	Sediment Investigation Area
SMS	Sediment Management Standards
SMU	Sediment Management Unit
SOW	Statement of Work
STAR	Sediment Transport Analysis Report
SQS	Sediment Quality Standards
TBC	"to be considered"
TCE	trichloroethene
TESC	Temporary Erosion and Sedimentation Control
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard

WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WQMP	Water Quality Monitoring Plan
WSDOH	Washington State Department of Health
WSDOT	Washington State Department of Transportation

DOCUMENT ROADMAP

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1 INTRODUCTION

This Basis of Design Report (BODR) has been prepared on behalf of Earle M. Jorgensen Company (EMJ) and Jorgensen Forge Corporation (Jorgensen Forge; herein referred to collectively as the Owner) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (AOC; EPA Region 10 CERCLA Docket No. 10-2013-0032) and attached Statement of Work (SOW). This BODR presents the Final Design submittal for the removal of contaminated sediments and associated bank soils in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge facility (Facility) located in Tukwila, King County, Washington (Figure 1; Jorgensen Forge Early Action Area [EAA]).

This BODR provides the basis of the design for in-water dredging, shoreline excavation, placement of backfill and armor materials, transport and off-site disposal of impacted sediments and soils, and associated construction and monitoring activities. The cleanup will be conducted as a non-time-critical removal action (NTCRA) in accordance with the U.S. Environmental Protection Agency's (EPA's) selected removal action alternative documented in the *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* (Action Memo; EPA 2011a) and detailed in the *Final Engineering Evaluation/Cost Analysis [EE/CA] – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA 2011a).

As documented in the EPA-approved Final EE/CA (Anchor QEA 2011a), the Jorgensen Forge EAA removal action boundary (RAB) was determined based on the nature and extent of chemicals that exceeded the Washington State Department of Ecology (Ecology) Sediment Management Standards (SMS) Sediment Quality Standards (SQS) criteria (Washington Administrative Code [WAC] 173-204-320). Polychlorinated biphenyl (PCB) concentrations have the greatest lateral and vertical distribution of SMS SQS criteria exceedances and encompass all other chemical concentration exceedances. Therefore, EPA approved that the RAB be determined based on SMS SQS PCB criteria exceedances (EPA 2008b). A detailed description of the RAB is provided in Section 2.

As identified in Section 4.1 of the Final EE/CA (Anchor QEA 2011a), the primary objective of the removal action is to reduce the chemical concentrations throughout the EPA-defined 0- to 1.5-foot vertical point of compliance (EPA 2008b) within the RAB to below the SMS SQS (termed the removal action level [RvAL] throughout this BODR) for PCBs and other chemicals. This reduction will significantly reduce unacceptable risks to human health and the environment resulting from potential exposure to elevated chemical concentrations.

A Preliminary Draft Biological Assessment (BA) and Preliminary Draft Clean Water Act (CWA) 404(b)(1) Evaluation were submitted to EPA as appendices to the Final EE/CA (Anchor QEA 2011a). The two documents were updated to reflect the preferred alternative selected in the Action Memo (EPA 2011a) and submitted to EPA in November 2011 and June 2012, respectively. EPA initiated formal Endangered Species Act (ESA) consultation with the Services (i.e., the National Marine Fisheries Service [NMFS] and the U.S. Fish and Wildlife Service [USFWS]) in late November 2011 through the submittal of the BA. Anchor QEA provided EPA with an updated CWA 404(b)(1) Evaluation based on their comments. EPA accepted the updates and provided final minor updates. Anchor QEA finalized the CWA 404(b)(1) Evaluation and submitted the final document at the end of June 2012. With this submission, Anchor QEA does not anticipate any further action related to this document. Anchor QEA and EPA responded to comments from the Services on the BA in February 2012. Formal ESA consultation was completed with the issuance of the Services' (BiOps) on August 22, 2012, and September 27, 2012, respectively. The BiOps cover activities occurring at the Boeing Plant 2 Duwamish Sediment Other Area (DSOA), Southwest Bank Corrective Measure and Habitat Project as well as at the Jorgenson Forge Facility and EAA4. The terms and conditions provided in the BiOps will be evaluated against the Owner's Final Design submittal to confirm consistency and applicability. If any issues are identified, the Owner will coordinate with EPA to address any inconsistencies.

The BODR also includes the following appendices that are a part of the Final Design submittal:

- Appendix A – Design Subsurface Sediment Characterization Supporting Documents
- Appendix B – Erosion Analysis
- Appendix C – Slope Stability Analysis
- Appendix D – Construction Quality Assurance Plan

- Appendix E – Water Quality Monitoring Plan
- Appendix F – Operations, Monitoring, and Maintenance Plan
- Appendix G – Construction Drawings
- Appendix H – Construction Specifications
- Appendix I – Sampling and Analysis Plan
- Appendix J – Green Remediation Strategy
- Appendix K – Health and Safety Plan
- Appendix L – Cost Estimate Details
- Appendix M – Cultural Resources Assessment

1.1 Background

EMJ entered into an AOC with EPA on July 10, 2003 (EPA Docket No. CERCLA-10-2003-0111), to investigate whether the Facility, which is currently owned and operated by Jorgensen Forge and formerly owned and operated by EMJ, is or has been a source of PCBs to the LDW. The analytical results of soil and sediment samples collected during the investigation detected concentrations of PCBs in sediment and soil on the shoreline bank in the LDW adjacent to the Facility. EPA determined that these concentrations present a risk to human health and the environment and met the criteria for conducting a NTCRA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; EPA 2008a). EPA and EMJ entered into the First Amendment to the AOC in April 2008. This amendment required EMJ to prepare an EE/CA, BA, and CWA Section 404(b)(1) Evaluation for the completion of a NTCRA of sediments and associated shoreline bank soil in the RAB that contain concentrations of chemicals that exceed the Ecology SMS SQS. The RAB was approved by EPA in 2008 (EPA 2008b).

The Owner previously submitted a Draft EE/CA, Second Draft EE/CA, and Final EE/CA to EPA in March 2009 (Anchor QEA 2009), November 2010 (Anchor QEA 2010), and October 2011 (Anchor QEA 2011a), respectively. EPA provided conditional approval of the Final EE/CA with slight modifications in a letter dated September 29, 2011, and subsequently provided formal approval of the Final EE/CA and selected the removal action alternative (Alternative 4 in the Final EE/CA) in the Action Memo (EPA 2011a). The issuance of the Action Memo completed the requirements of the AOC (EPA Docket No. CERCLA-10-2003-

0111). Design, construction and long-term operations, maintenance, and monitoring are being conducted under a new AOC (EPA Docket No. 10-2013-0032) entered into between EPA and EMJ.

The Boeing Company (Boeing) is conducting an interim corrective action under the Resource Conservation and Recovery Act (RCRA) adjacent to the Boeing Plant 2 Facility in the area immediately adjacent and downstream from the RAB (Figure 1). This corrective action area is termed the DSOA and Southwest Bank Corrective Measure and is also identified as an EAA by EPA. EPA collectively defined the DSOA and the Jorgensen Forge EAA as EAA-4. Due to the adjacency of these EAAs, the First Amendment to the Investigation AOC (EPA 2008a) between EMJ and EPA incorporated a Memorandum of Understanding (MOU) executed by the Owner and Boeing. The MOU administratively requires the coordination and cooperation of all parties conducting cleanup within the adjoining Boeing DSOA and RAB. This BODR incorporates and fulfills this requirement.

This BODR also discusses the removal action that will be performed by Jorgensen Forge and Boeing under a Second Modification (date pending) to the AOC with the EPA Office of Emergency Response. As discussed in Section 2.2.2.1, the removal action will include removal of the inactive corrugated metal pipes (CMP) and underlying soils with PCBs that exist in the northwest corner of the Jorgensen Forge property (Figure 2). This work is scheduled to be conducted either prior to or concurrently with the removal action activities within the RAB. In either case, the removal action will be directly adjacent to the RAB shoreline reconfiguration so the designs for these removal action activities will be integrated.

This BODR does not account for the cleanup that will be conducted in the EPA-identified EAA-5 cleanup at Terminal 117 directly across the LDW from the Facility (Figure 1) as it will be initiated following the scheduled completion of the removal action within the RAB.

1.2 Report Organization

The BODR is organized into the following sections:

- Section 2 – Removal Action Description
- Section 3 – Site Characteristics

- Section 4 – Dredge Plan
- Section 5 – Backfill Plan
- Section 6 – Slope Containment Plan
- Section 7 – Habitat Enhancement Plan
- Section 8 – Short-term Impacts During Construction
- Section 9 – Substantive Requirements of Permits
- Section 10 – Construction Sequencing and Schedule
- Section 11 – Long-term Operations, Monitoring and Maintenance
- Section 12 – Institutional Controls
- Section 13 – References

2 REMOVAL ACTION DESCRIPTION

The following sections provide a summary of the design guidance, Facility source control, selected removal action alternative, and green remediation guidance.

2.1 Design Guidance

2.1.1 Removal Action Objectives

As described in Section 4.1 of the EE/CA, the removal action is being prepared prior to the Record of Decision (ROD) for the LDW Superfund Site; therefore, removal action objectives (RAOs) and final removal action standards, including the vertical point of compliance, target media removal action levels, and sediment removal action boundaries, are not available for use in this BODR. In order to facilitate development of this BODR prior to completion of the ROD, EPA directed (EPA 2010) that the following RAOs be used for the removal action to maintain consistency with the current removal action objectives required throughout the LDW Superfund Site:

1. Human Health – Seafood Consumption. Reduce human health risks associated with the consumption of resident LDW seafood by reducing sediment and surface water concentrations of chemicals of concern (COCs) to protective levels.
2. Human Health – Direct Contact. Reduce human health risks associated with exposure to COCs through direct contact with sediments and incidental sediment ingestion by reducing sediment concentrations of COCs to protective levels.
3. Ecological Health – Benthic. Reduce toxicity to benthic invertebrates by reducing sediment concentrations of COCs to comply with Ecology SMS SQS.
4. Ecological Health – Seafood Consumption. Reduce risks to crabs, fish, birds, and mammals from exposure to COCs by reducing concentrations of COCs in sediment and surface water to protective levels.
5. Groundwater and Sediment Protection. Reduce migration of contaminants in groundwater to sediments to reduce risk to human health and the environment.

To achieve these RAOs in the 0-to 1.5-foot vertical point of compliance, EPA directed the use of the SQS for total PCBs (12 milligrams per kilogram of normalized organic carbon [mg/kg-OC]) as the appropriate delineating criterion and the appropriate RvAL for sediment removal and/or shoreline containment in the RAB (EPA 2010a). The use of the total PCB SQS criterion as the RvAL for sediment removal and shoreline containment is consistent with the LDW Slip 4 EAA, Terminal 117 EAA, and Boeing Plant 2 DSOA EAA cleanups.

As identified in EPA's Action Memo (EPA 2011a), the EPA-selected removal action will meet the above RAOs with the exception of the RAO for human seafood consumption over the long term. The Action Memo states:

> *"The RBCs* [Risk Based Concentration] *necessary to protect unlimited human seafood consumption are very stringent. The goal for the LDW as a whole is to get as close to them as practicable. Achieving them may be impossible as they are more stringent than background concentrations, including natural background as defined by MTCA. However, this sediment removal will remove all contaminant concentrations over its aerial extent and will replace them with clean fill material meeting the backfill levels for final actions. Upon completion therefore, these formerly contaminated sediments will meet all cleanup goals and levels until they are recontaminated, to however marginal degree, by surrounding LDW concentrations, and LDW sources generally. These later post-NTCRA levels will be addressed by the LDW Record of Decision in a manner consistent with the rest of the LDW since the Jorgensen Forge EAA will remain part of the LDW site after this NTCRA is completed. It is important to emphasize that protective levels of COCs, particularly PCBs, are well below background concentrations, so it will not be possible, based on everything we know at this time, over the long term, to completely eliminate any unacceptable risk from this pathway without limiting fish consumption to some degree".*

2.1.2 Performance Standards

To achieve the Jorgensen Forge EAA RAOs, performance standards were established and are described as follows. These performance standards were used to guide the removal action design, construction, construction verification, and long-term monitoring activities.

2.1.2.1 In-water Dredging and Off-site Disposal

The following in-water dredging and off-site disposal performance standards were established:

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- Impacted sediment, defined as sediments containing total PCB concentrations greater than the PCB RvAL (12 mg/kg OC) shall be removed within the EPA-approved RAB.
- The work shall be completed consistent with best management practices (BMPs) in order to minimize dredge residuals, releases, and recontamination of adjacent areas outside the RAB.
- The work shall be completed consistent with BMPs and 401(c) Water Quality Memorandum requirements in order to minimize water quality impacts outside the compliance boundary.
- The dredged sediment shall be transported to a future identified off-site offloading facility anticipated to be located within the LDW Site and subsequently hauled and disposed at an approved landfill facility.

2.1.2.2 Backfill of Dredge Areas

The following backfill performance standards in dredge areas were established:

- Areas dredged or excavated to remove sediments and soils exceeding the PCB RvAL shall be restored to roughly the pre-removal grade with backfill material. Some areas within and directly adjacent to the navigation channel and on the shoreline bank may be at lower elevations following backfilling than pre-removal grade.
- The gradation of the backfill material shall be such that the surface of the backfill material generally remains stable without significant erosion.
- Imported backfill material shall meet defined chemical and geotechnical goals.
- The work shall be completed consistent with BMPs in order to minimize adjacent slope instability and dredge residuals migration.
- The work shall be completed consistent with BMPs and the EPA-prepared 401(c) Water Quality Memorandum requirements in order to minimize water quality impacts outside the compliance boundary.

2.1.2.3 Shoreline Stabilization

The following shoreline stabilization performance standards were established:

- The shoreline bank shall be regraded to a flatter slope to promote better long-term stability.

- The nearshore bank sediment, soil, pilings, concrete, and debris excavated from the designated shoreline shall be disposed of at an approved landfill facility.
- The excavated surface of the shoreline bank shall be contained and armored to resist erosion and instability. The surface armoring shall be designed to resist bed shear velocities induced by a 100-year flood flow, 100-year wind-induced waves, vessel-induced waves from typical passing vessels, and anticipated propeller wash from vessels that operate in the area. The armoring design also accounts for projected sea level rise in the Puget Sound area.
- The target total thickness of the shoreline bank containment shall be a minimum of 4 feet thick and will include 1.5 feet of filter material overlain by 2.5 feet of armor overlain by 0.5 feet of habitat material.
- Imported shoreline bank stabilization materials shall meet defined chemical and geotechnical goals.
- The work shall be completed consistent with BMPs in order to minimize slope instability during construction, in-water work based on tidal elevations during construction, and excavation residuals migration.
- The work shall be completed consistent with BMPs and 401(c) Water Quality Memorandum requirements in order to minimize water quality impacts outside the compliance boundary.

2.2 Source Control

The following subsections summarize the current status of Facility and off-site source control.

2.2.1 Facility Source Control

Jorgensen Forge entered into an Agreed Order (AO; Docket No. DE 4127) with Ecology to conduct a source control evaluation to determine if there are ongoing sources of chemicals from the Facility to the LDW sediments and/or water column that are above applicable screening levels. Ecology is the lead agency for controlling ongoing sources of hazardous substances to the LDW and has developed the *Lower Duwamish Water Source Control Strategy* (Ecology 2004). The source control evaluation was conducted and sequenced such that the nature and extent of potential ongoing sources of chemicals from the Facility to the

LDW will be documented and controlled prior to initiation of sediment removal action activities to minimize the potential for sediment recontamination following removal action.

The Facility source control investigations completed to date and findings are comprehensively summarized in the Source Control Evaluation Report (SCER; Anchor and Farallon 2008a) and SCER Addendum (Anchor QEA and Farallon 2009). These documents resulted in the development of a conceptual site model (CSM) that facilitated evaluation of the possible migration pathways for chemicals of interest (COIs) from the Sediment Investigation Area (SIA) that may represent an ongoing source of chemical concentrations to the LDW above sediment and surface water screening levels. COIs are specifically those chemicals that were used in historical operations or otherwise known to be present on the SIA at detectable concentrations.

The results of the source control investigation, including the information obtained through source control data gap sampling activities conducted in 2009, indicate the following ongoing or potential future sources of COCs (chemicals with concentrations above relevant screening levels) to the LDW from the SIA and the recommended path forward for source control implementation, if necessary:

- Direct discharge of COCs in products associated with ongoing operations on the SIA to the stormwater system with subsequent discharge to the LDW through SIA outfalls 001, 002, or 003.
  - No additional source control implementation is necessary for this pathway beyond continued implementation of existing BMPs.
- Erosion of exposed soil containing PCBs and metals to the stormwater system with subsequent discharge to the LDW through SIA outfalls 001, 002, or 003.
  - No additional source control implementation is necessary for this pathway beyond the continued implementation of existing BMPs.
- Discharge of SIA stormwater to the LDW through outfalls 001, 002, or 003 containing concentrations of metals.
  - Additional source control implementation is necessary by Jorgensen Forge beyond the continued implementation of existing BMPs and monitoring.

The migration pathway for discharge of groundwater is complete but concentrations of COCs have not been detected in groundwater exceeding the screening levels, with the exception of single anomalous detections of COCs in groundwater collected from single monitoring wells located in discrete areas of the SIA distant from the LDW. As discussed in the SCER Addendum (Anchor QEA and Farallon 2009), the COCs detected in groundwater exceeding the screening levels on the SIA do not pose a risk to the sediment or surface water of the LDW. The potential for ongoing releases of products to soil and groundwater is minimized through the implementation of BMPs and a Spill Prevention, Control, and Countermeasure Plan (Anchor QEA 2013c).

The erosion of exposed soil containing concentrations of PCBs and metals along the shoreline bank is an incomplete pathway to the LDW because the shoreline is heavily armored and significantly limits any potential erosion of bank fill material.

The necessary source control actions to reduce stormwater discharge concentrations from the SIA below the applicable benchmarks are being completed in accordance with the Facility's National Pollutant Discharge Elimination System (NPDES) Industrial Stormwater General Permit (Permit No. WAR003231) and sequenced so that the sources are controlled prior to initiation of sediment removal action activities. In accordance with the Permit and AO (Docket No. 9429), Jorgensen Forge submitted an Engineering Report (Anchor QEA 2012) to Ecology on May 18, 2012 and it was subsequently approved by Ecology on September 6, 2012. Plans and specifications detailing the treatment system design were submitted to Ecology on October 12, 2012, and Jorgensen Forge completed installation and startup of the treatment system on January 13, 2013. The stormwater treatment system is currently in operation and Jorgensen Forge is conducting monthly monitoring to evaluate the system performance with respect to Permit benchmarks, as well as the potential for sediment recontamination from Facility stormwater discharge.

2.2.2 Off-site Source Control

The SCER (Anchor and Farallon 2008) identified potential off-site sources of chemicals to the LDW sediments in the vicinity of the SIA from adjacent upland properties. In addition, review of sediment quality and sediment transport and deposition information presented in the LDW Final RI (Windward 2010) indicates off-site sediments with elevated chemical concentrations have the potential to migrate into the RAB. A brief summary of these potential sources is provided in the following subsections. Control of some of these off-site sources are beyond the control of the Owner but will be critical to the long-term success of the removal action within the RAB.

2.2.2.1 Property Line Storm Pipe Outfall Solids

Elevated concentrations of total PCBs have been identified in the inactive Boeing 12-inch storm pipe and directly-adjacent inactive 24-inch property line storm pipe (collectively referred to as property line storm pipes) that transit the northern Facility property boundary (Figure 2). Historical inputs to the Boeing 12-inch property line storm pipe were solely from Plant 2. Historical stormwater inputs to the 24-inch property line storm pipe were primarily from Plant 2 and Boeing Field/King County International Airport and to a lesser extent the Facility and the City of Tukwila stormwater drainage. A summary of the investigations and data findings and evaluations is summarized in the *Storm Drain Line Data Summary* technical memorandum (Farallon 2005) and *Historical 6-inch and 12-inch Lateral Pipes Investigation Report – Stormwater Source Control Implementation, Jorgensen Forge Facility, Seattle, Washington* (Anchor QEA 2010b).

EPA prepared the *Action Memorandum for the Jorgensen Forge Outfall Site, Seattle, King County, Washington* (2010b). This memorandum documented approval of the selected time-critical removal action under CERCLA for removal action activities associated with the concrete portions of the property line storm pipes that discharge to the RAB. Boeing and Jorgensen Forge are named as potentially responsible parties in the Action Memo. Boeing performed the removal action actions and Jorgensen Forge provided access to the Facility. As required by the Action Memorandum, Boeing submitted the *Source Control Action – 15-inch and 24-inch Pipes Cleanout Work Plan* detailing the removal action and closure activities on December 17, 2010 (Floyd|Snider 2010). The removal action consisted of the cleaning and closure of the concrete portions of the full extents of both property line storm pipes on the Facility to remove and prevent continued discharge of stormwater through known PCB contamination to the LDW. Boeing initiated the removal action and closure activities in November 2010 and submitted the Source Control Action Completion Report dated May 27, 2011 (Floyd|Snider 2011). EPA approved the removal action and closure activities in a letter dated July 15, 2011 (EPA 2011b).

As part of the removal action and closure activities, Boeing also completed soil sampling along the top of shoreline bank area near the alignment of the property line storm pipes. This investigation identified elevated PCB concentrations in soil at depths from 8- to 25-feet below ground surface (bgs) in the vicinity of the northwest corner of the Facility directly adjacent to the property boundary with the Plant 2 (Figure 3). Due to these findings, EPA required the completion of additional focused soil sampling under a First Modification to the AOC entered into by Jorgensen Forge and Boeing in September 2011. Jorgensen Forge completed the additional soil investigation in March 2012 in accordance with the Phase 2 Geoprobe Soil Investigation Work Plan (Anchor QEA and Farallon Consulting 2012a). The results were presented in the Phase 2 Geoprobe Investigation Summary Report – Jorgensen Forge Outfall Site (Anchor QEA and Farallon Consulting 2012b), and EPA approved completion of the First Modification to the AOC work in a letter to Jorgensen Forge dated September 11, 2012.

Although the existing Phase 1 and Phase 2 Investigation lateral data density is very high (Geoprobe borings spaced approximately 2 to 10 feet apart throughout the Site), there were three borings where the deepest soil sample collected contained total PCBs greater than the 1 milligram per kilogram (mg/kg) total PCB screening level. In coordination with EPA and Ecology, Jorgensen Forge and Boeing developed the *Work Plan Addendum for Additional Vertical Polychlorinated Biphenyls Characterization in Soil – Jorgensen Forge Outfall Site* (Anchor QEA and Floyd|Snider 2012) to further assess the vertical extent of total PCBs greater than 1 mg/kg (referred to as the Phase 3 Investigation) at these isolated locations. Jorgensen Forge managed performance of the work in December 2012 with oversight by Boeing. A summary of the Phase 3 Investigation results is detailed in the *Results of Additional Soil Geoprobe Vertical Characterization at the Jorgensen Forge Outfall Site* (Anchor QEA 2013a).

Jorgensen Forge and Boeing are currently coordinating with EPA for a Second Modification to the AOC that will require the removal of the CMP that exists in the furthest

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downgradient portions of the property line pipes as well as soils in the direct vicinity of these pipes that contain total PCB concentrations greater than 1 mg/kg (Figure 3). Jorgensen Forge and Boeing are evaluating the schedule for execution of the Second Modification to the AOC and development of the removal action design documents. At a minimum, a sheetpile wall will be installed on the shoreline bank at the appropriate schedule to facilitate the sediment removal action activities within the RAB immediately adjacent to the sheetpile wall. This BODR and attached Final Design documents account for the presence of this sheetpile wall so the abutting removal action activities will be successfully integrated and sequenced to prevent delays to either removal action. Just prior to installation of the sheetpile wall, additional angled Geoprobe borings will be performed to further characterize the sediment and soil quality immediately water-side of the wall beneath the design shoreline bank excavation grades identified in the Construction Drawings (Appendix G of this BODR). This data will inform whether additional removal below the current design shoreline bank excavation grades will be necessary during the removal action in the RAB and the appropriate disposal removal facility for any additional removed materials.

2.2.2.2 Boeing Plant 2 2-66 Study Area

The 2-66 Study Area is located along the southwest corner of Boeing Plant 2 and borders Boeing DSOA and northwest corner of the Facility (Figure 2). This area includes the Southwest Bank CMS Study Area and the Transformer PCB Investigation Area (referred to as OA-11 [Floyd|Snider 2007]). Migration of chemicals from the 2-66 Study Area to the Facility and LDW sediments has occurred from two sources. They include an underground storage tank located outside the southwestern corner of former Building 2-66 that historically stored trichloroethene (TCE) and a piping system that was and continues to be a source of TCE degradation byproducts to groundwater on the northwest corner of the Facility.

Quarterly and semi-annual groundwater monitoring conducted by Boeing, including monitoring wells located along the northwestern corner of the Facility (PL2-JF01AR, PL2-JF01B, PL2-JF01C, PL2-JF02A, and historically PL2-03A; Figure 4), has consistently shown detections of elevated halogenated volatile organic compounds (HVOCs; dichloroethene [DCE], and vinyl chloride) due to the deflection of groundwater around the

2-66 sheetpile enclosure and onto the northwest corner of the Facility. Sediment porewater monitoring (Windward 2006) adjacent to the Southwest Bank Area also identified detections of HVOCs documenting that the TCE plume has a complete pathway to the LDW sediments adjacent to the northwest portion of the Facility within the Boeing DSOA. Boeing recently completed soil removal within the sheetpile enclosure under EPA oversight to remove soils impacted by HVOCs. It is currently unclear what additional source control measures Boeing will take to control this known source of HVOCs to the Boeing DSOA immediately downstream from the RAB.

The Southwest Bank Area (Figure 2; Boeing DSOA bank extending downstream/north from the southern Plant 2 property boundary) is composed of riprap and a significant amount of debris fill containing concrete rubble, metal scraps, and brick. Soil samples were collected from the Southwest Bank Area and showed metals and PCB concentrations above the SQS criteria (Ecology 2007). Boeing's proposed remedy for the DSOA (AMEC and Floyd|Snider 2010) includes reconfiguring the Southwest Bank Area to eliminate this potential bank erosion pathway.

Per the MOU between Boeing and the Owner (EMJ et al. 2007), the southern portion of the Boeing DSOA and Southwest Bank Area cleanup is anticipated to occur immediately following the removal action within the RAB and the backfill operations for both projects will be sequenced to minimize the potential for recontamination of the RAB, Boeing DSOA, and Southwest Bank Area.

2.2.2.3 Sediment to Sediment Pathway

The LDW Final RI (Windward 2010) defines the nature and extent of sediment concentrations throughout the LDW. Elevated concentrations for a variety of chemicals have been documented throughout the LDW, particularly in the direct vicinity of the RAB. Specifically, the sediments adjacent to the following properties have been identified as EAAs due to elevated PCB concentrations in surface and subsurface sediments: Boeing DSOA (southern portion of EAA-4), Terminal 117 on the west bank of the LDW directly across the RAB (EAA-5), and the Boeing-Isaacson Property combined sewer overflow (CSO) discharge location (EAA-6; Figure 1). Per the MOU between Boeing and the Owner (EMJ et al. 2007), the removal actions within the Boeing DSOA and the RAB are required to be integrated and sequenced to minimize the potential for recontamination of sediments adjacent to either facility during and prior to removal action. EPA has also committed to completing the EAA-5 cleanup concurrent with the Boeing DSOA and RAB cleanups during the 2013 in-water work window, although the current schedules shows the EAA-5 cleanup initiating following completion of the RAB cleanup. EPA will require the use of sufficient environmental controls during these cleanup actions to significantly minimize the potential for sediment transport and deposition to the RAB during the cleanup activities.

Alternatively, EAA-6, which is located immediately upstream of the RAB, and other sediment areas further upstream are not currently scheduled for cleanup prior to cleanup in the RAB. Ongoing releases and/or sediment transport and deposition to the RAB from these areas could contribute elevated chemical concentrations to the RAB following completion of the removal action. Long-term monitoring within the RAB will document the sediment quality impacts due to this ongoing off-site source loading.

2.3 Selected Removal Action Alternative

The EPA-approved removal action alternative (EPA 2011a) includes the vertical and horizontal removal of all total PCB RvAL sediment and shoreline bank exceedances identified within the RAB. In accordance with EPA's direction, the RAB was developed by screening all of the available sediment and shoreline bank soils total PCB data against the total PCB RvAL. Based on the findings of the data screening and the site-specific conditions described in the Final EE/CA (Anchor QEA 2011a), the EPA-approved RAB was identified as the approximately 1.6-acre area shown in Figure 4, and is bounded by the following:

- To the east by the top of shoreline bank (including the top of sheetpile and concrete panel walls) extending from the northern to southern Facility property boundaries, with two areas extending just beyond the top of bank, as discussed below
- To the south by the extension of the southern Facility property boundary from the top of the concrete panel wall to the eastern boundary of the federal navigation channel
- To the west by the eastern boundary of the federal navigation channel extending from the southern boundary to the Boeing DSOA in-water cleanup boundary

identified in the MOU (EMJ et al. 2007) followed by the surveyed (during low tide on August 28, 2008) toe of riprap elevation north of the in-water cleanup boundary

  - Per EPA's letter (2008b), the western boundary includes an isolated 20-foot extension into the federal navigation channel centered on station SD-322-S

- To the north by two boundaries: 1) the Boeing DSOA in-water cleanup boundary on the southern end; and 2) the Facility northern property line on the northern end

The removal action includes shoreline bank excavation and placement of slope containment materials. This portion of the shoreline is degraded, containing elevated chemical concentrations above the SMS SQS criteria and total PCB RvAL exceedances; highly armored and over-steepened (approximately 1 to 1 horizontal to vertical slope [1H:1V slope]) banks; and, contains derelict creosote-treated piles, remnant overhanging asphalt pads, and other types of debris. Existing derelict creosote-treated piles, overhanging asphalt structures, and debris (Figures 5a, 5b, and 5c) will be removed from the bank prior to excavation and slope containment. Upon excavation to the target depths, inert debris identified along the new surface may be allowed to remain in place if doing so would not affect the function of the overlying slope containment. The removed materials will be transported and disposed at an off-site RCRA-permitted Subtitle D disposal facility.

Following completion of the shoreline bank excavation to the design grades, clean slope containment materials will be placed on the post-excavation surface. The slope containment will be composed of a 1.5-foot "filter" layer amended with granular activated carbon (GAC; consisting of sandy gravel to gravelly sand) overlain by a 2.5-foot "armor" layer (consisting of light loose riprap) further overlain by a 0.5-foot layer of habitat substrate (anticipated to consist of rounded or sub-rounded 2.5-inch minus gravel). The filter layer will act as a containment layer, the armor layer will function to protect the filter layer from erosion, and the habitat layer will provide a uniform habitat substrate within the intertidal areas that functions to fill the interstitial areas of the armor layer.

The removal action will be completed such that impacts to the existing sheetpile wall and concrete panel walls are minimized, as well as existing in use concrete foundations and structures within close proximity of the top of shoreline bank. This will include offsets during dredging to minimize undermining as well as damage from construction equipment.

2.4 Additional Soil Removal Action

Concurrent with completion of the shoreline bank excavation, Ecology recommended that Jorgensen Forge consider removal of additional soil from the top of shoreline bank proximate to borings SB-3 and SB-4 containing surface total PCB concentrations above the Washington State Model Toxics Control Act Cleanup Regulation (MTCA) Method A soil cleanup levels for industrial properties (10 mg/kg total PCBs), as established in Section 745 of Chapter 173-340 of the WAC (Figure 8). The total PCB soil concentration at SB-3 is 17.8 mg/kg in the 0- to 2-foot interval and 6.8, 1.9, and 11. 3 mg/kg in the 0- to 2-foot, 2- to 4-foot, and 4- to 6-foot intervals at SB-4. All observed total PCB concentrations in SB-1, SB-2, SB-5, SB-6, and SB-7 across the remainder of the top of shoreline bank were well below the MTCA Method A industrial land use cleanup level.

The removal action design shoreline bank excavation grades extend through soils in the direct vicinity of SB-3 and SB-4. The Contractor will also will also have mobile equipment working in the vicinity of these borings in order to perform the shoreline bank excavation. Jorgensen Forge is concerned these soil disturbances could lead to track-out of soils containing PCBs to nearby upland surfaces. Due to these concerns, Jorgensen Forge has agreed to conduct the additional removal as shown in Figure 8. The area of additional removal is beyond the proposed reconfigured top of bank described in the EPA-approved Final EE/CA and Action Memorandum (EPA 2011a) so this removal will not be administered under the EPA AOC. Rather, this additional soil removal will be completed by Jorgensen Forge as an Interim Action under an amendment to the existing Ecology Agreed Order (No. DE 4127) at the Facility. The amendment is currently being developed by Ecology. The soil removal will be performed concurrently with the EPA removal action shoreline bank reconfiguration activities (see Section 10).

2.5 Construction Strategy

Due to ESA considerations, work in the RAB and below the mean higher high water (MHHW) elevation is restricted to only typically occur between August 1 and February 15 of

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each year (EPA 2013), unless modified by EPA and the Services. It is anticipated that work will be able to be performed 24 hours per day consistent with the Boeing cleanup activities in the northern portion of the DSOA. The dredging work (Section 4) will be sequenced and coordinated with Boeing and is expected to be performed from generally upstream to downstream and generally from the top of the bank to the bottom. This will minimize slope instabilities, the amount of in-water work and potential impacts, as well as the amount of residual material that could be left in place.

The shoreline bank work will be completed to the maximum extent practicable with land-based equipment and "in the dry" given the tidal conditions during the construction period. It is anticipated that the shoreline bank materials will be loaded into trucks and either hauled directly to an approved offsite Subtitle D landfill or hauled to a transloading facility and transferred to rail cars for transport to a Subtitle D landfill. The entire reconfigured shoreline bank from the newly constructed toe to the top of bank will be armored to prevent erosion of the bank. The new top of bank (approximately 20 feet mean lower low water [MLLW] elevation) is significantly higher than the 11 feet MHHW elevation and projected increases in water surface elevations due to sea level rise, so the shoreline bank armor design conservatively protects the bank from LDW currents and waves.

The in-water work will be performed with a closed environmental bucket (e.g., Young's Bucket) to the maximum extent possible given the physical characteristics of the encountered materials. A conventional derrick with clamshell, grapple, or vibratory hammer will be used as necessary for removal of large debris and piling. The articulated bucket will be mounted on an excavator that is located on a barge. It is anticipated that the removed materials will be loaded into a haul barge, dewatered on the barge, and hauled to a transloading facility where it will be loaded into rail cars for transport to a Subtitle D landfill. The dewater fluids will be treated as necessary on a barge (similar to Slip 4 EAA removal action process) or on the landside (similar to ongoing Boeing DSOA cleanup) prior to discharge back into the LDW.

Verification of the completion of dredging and shoreline reconfiguration requirements will be performed on a "management unit" basis. A dredge management unit (DMU) is a dredging area within the RAB that will be used for assessing compliance with elevation targets and dredging thickness removal. Following completion of each sediment and shoreline bank DMU, those areas will be covered with a 3- to 6-inch layer of interim backfill or filter material to limit the potential for resuspension and release of sediments and soil. Subunits will be determined during construction. The number and orientation of DMUs will be determined in coordination with the Engineer and Contractor based on the Contractor's means, methods, and construction sequencing. The DMUs will be sized such that enough area can be dredged and managed before covering, but not too large such that the effect of the cover minimizing resuspension is lost.

When all dredging and shoreline bank excavation is complete the RAB will be backfilled with a sand and gravel mix to nominally restore the previous elevations, except within 10 feet of and inside the navigation channel where the final target backfill elevations will be lower than the existing mudline to support navigation channel elevations maintained by the U.S. Army Corps of Engineers (USACE) approximately 2 feet below the authorized navigational channel depth of -15 feet MLLW (USACE 2010).

2.6 Green Remediation Strategy

The Owner is committed to integrating appropriate removal action activities using methods and procedures that conserve natural resources in accordance with EPA Region 10 "Clean and Green Policy". This policy attempts to increase the environmental sustainability and benefits of remediation completed at Superfund sites and provides guidance on specific goals for environmental performance during the completion of remediation activities.

The removal action design has incorporated this policy guidance where relevant and practicable. Appendix J provides a summary of the strategy elements that were incorporated into the removal action design to increase the environmental sustainability and benefits.

3 SITE CHARACTERISTICS

3.1 Adjacent Land Uses and Ownership

This section summarizes the land uses and ownership of the properties adjacent to the Facility. No Washington State Department of Natural Resources (WDNR)-permitted aquatic land uses exist within the Jorgensen Forge EAA or at the surrounding properties.

Land uses and ownership directly north and south of the Facility include:

- **Boeing Plant 2**: Located adjacent and directly north/downstream of the Facility, it occupies approximately 109 acres of developed topographically flat land covered by buildings and paved yards. Since 1936, Boeing Plant 2 specialized in manufacturing aluminum alloy, steel alloy, and titanium alloy parts for airplanes using a wide range of hazardous chemicals including heavy metals (i.e., chromium, zinc, copper, cadmium, and silver), cyanide, mineral acids and bases, petroleum products, PCBs, and chlorinated solvents such as TCE. In recent years, the function of Plant 2 has shifted toward research and administration (Floyd|Snider 2007).
- **Boeing-Isaacson Property**: located directly south/upstream from the Facility, it is a 9.7-acre rectangular parcel that has had mixed uses. From the 1920s to 1949, a portion of the land was used as a lumber mill. In the early 1950s, the Isaacson Structural Steel Company purchased the Boeing-Isaacson Property and conducted galvanizing, steel fabrication, and storage through the 1960s (ERM and Exponent 2000). This property is also the discharge point for the combined King County International Airport Middle Outfall and Seattle Public Utilities CSO No. 156. The sediments adjacent to the discharge point have been identified by EPA as EAA-6 due to elevated chemical concentrations, primarily PCBs.

Further details on these facilities, including facility history, development, and status of source control evaluations, can be found in the *Lower Duwamish Waterway Early Action Area 4 Final Summary of Available Information and Identification of Data Gaps Report* (Ecology and Environment 2007) and *Lower Duwamish Waterway Source Control Action Plan for Early Action Area 4* (Ecology 2007).

Directly east of the Facility is East Marginal Way South, which is bounded further to the east by the King County International Airport. Directly west of the Facility is the shoreline bank and LDW. The Port of Seattle manages the lands from the top of the shoreline bank to the eastern boundary of the federal navigation channel as successor in interest to the King County Commercial Waterway District No. 1 (often referred to as Duwamish Commercial Waterway District No. 1).

3.2 Physical Setting

This section summarizes the physical setting within the RAB and at the Facility. Further details and information on the physical characteristics of the Facility are provided in the SCER (Anchor and Farallon 2008a).

3.2.1 Shoreline Conditions, Outfalls and Debris

Figures 5a through 5c show photographs of the shoreline conditions during a low tide (approximately –3 feet MLLW), both within the RAB and immediately upstream and downstream. The shoreline north of the sheetpile wall is steep (approximately 1H:1V) and covered with a combination of riprap, concrete blocks, chunks of asphalt, other debris, and approximately 40 visible aboveground remnant timber piles of variable length. The shoreline also includes the following features:

- Six historical inactive (i.e., abandoned) outfall discharge pipes (outfalls 004, 005, 006, 007, 008, and 009) that extend through the bank along this portion of the shoreline.
- A single inactive stormwater outfall that has never been managed by the Facility also discharges through the shoreline bank. Previous investigations by Boeing and Jorgensen Forge identified that this outfall has conveyed discharges from two pipes, referred to as the Boeing 12-inch and 24-inch property line storm pipes (see Section 2.2.2.1). This outfall was abandoned in 2011.
- Remnant timber decking along the bank and overhanging a small portion of the shoreline above outfall 008.
- A small cantilevered concrete pad slightly overhanging the top of bank adjacent to outfall 007.
- Several debris piles that look to be composed of solidified molten metal at the toe of the bank between outfalls 004 and 006.

The shoreline along the approximately southern 100 linear feet of the RAB contains a gradual sloping mudline adjacent to an abutted sheetpile wall and concrete panel wall. The slope along the sheetpile wall contains scattered larger debris, riprap, and cobble with decreasing coverage of cobble farther towards the channel. The slope adjacent to the majority of the concrete panel wall is a mudflat with limited scattered cobble. A large building is located approximately 20 feet east of the top of the sheetpile and concrete panel walls.

No utility crossings through the RAB have been identified.

3.2.2 Topography and Bathymetry

The topography within the RAB is relatively flat and ranges from elevations of approximately 19 to 20 feet MLLW at the top of shoreline bank.

The mudline elevation along the eastern edge of the federal navigation channel within the RAB ranges from -10 to -14 feet MLLW. As shown in Figures 5a through 5b, the shoreline bank area is steep (approximately 1H:1V slope) north/downstream of the sheetpile wall, with a more gradual slope below the toe of slope extending to the navigation channel. The mudline elevation adjacent to the sheetpile wall is approximately 5 feet MLLW with a generally constant gradual slope extending to the navigation channel. The mudline elevation adjacent to the concrete panel wall is approximately 2 feet MLLW with a relatively gentler slope starting extending from this elevation resulting in a localized mudflat area.

3.2.3 Geotechnical

A number of upland and offshore sediment sampling investigations have been conducted in and around the Facility.

Previous subsurface investigations conducted at the Facility indicated that the upland soils are primarily fill material consisting of gray and brown sand that ranges from very fine to coarse subrounded grains. The fill material appears to extend to a depth of 2 to 10 feet bgs. A pervasive silt layer with organic material is encountered between 8 and 10 feet bgs and represents the uppermost native soil. The uppermost native soil generally consists of a 1- to 3-foot-thick, organic-rich, dark gray silt to clayey silt layer.

Offshore sediment characterizations within the RAB have identified surface sediments containing between 40 to 80 percent fines (clay and silt) near the federal navigation channel with a general decrease in fines to between 20 to 60 percent in the nearshore areas. The shoreline bank area has less than 40 percent fines with several areas with significant armoring and/or debris showing less than 20 percent fines. Total organic carbon (TOC) generally ranges from 1.4 to 3.4 percent, with generally higher percentages adjacent to the federal navigation channel.

Core logs from these various sediment investigations generally showed a variable thickness of recently deposited silts underlain by upper alluvium interbedded silts and sands. Consistent with the lithology identified in the LDW Final Remedial Investigation (Windward 2010), the bottom depths of some cores showed a lower alluvium layer consisting of non-silty dense sand.

A comprehensive summary of the various upland soil and offshore sediment sampling investigations are summarized in the SCER (Anchor and Farallon 2008) and *Final Investigation Data Summary Report* (Anchor and Farallon 2006), respectively.

3.2.4 Hydrogeology

The drainage basin into the LDW is underlain by a single, large alluvial aquifer system that extends from the water table at 10 feet bgs to a depth of 70 to 80 feet bgs. The Facility is underlain by heterogeneous lenses and layers of silt and clay with no identified discrete zones, and only a few units can be correlated within the Facility's monitoring wells.

The stratigraphy is further complicated by placement of fill atop the pre-development topography, including placement of fill between May 1944 and July 1945 into the previously existing embayment located in the central western portion of the Facility property. Groundwater at the Facility is typically encountered from 9 to 13 feet bgs. The observed groundwater conditions during semi-annual groundwater monitoring events indicate that the groundwater flow direction is to the southwest on the eastern half of the Facility with the gradient increasing and the flow direction becoming more westerly toward the shoreline (Anchor QEA and Farallon 2009).

3.2.5 Surface Water Hydrology and Tidal Conditions

Numerous hydrologic studies in the LDW have evaluated the general circulation patterns and characteristics in the vicinity of the project site but no site-specific studies have been conducted. As part of the *Draft Final Feasibility Study: Lower Duwamish Waterway* (AECOM 2010), a hydrodynamic model was performed to assess discharge, velocity, and depositional/erosional areas throughout the LDW Superfund Site. This information can be generally applied at the RAB.

The hydrology within RAB is influenced primarily by general circulation patterns in the LDW. Average downstream flow for the LDW as measured at the Tukwila gaging station was 1,533 cubic feet per second (cfs) during 2003 to 2004 and ranged from 327 cfs in August to 3,290 cfs in June (Clemens 2007). Flow rates are greatest during the winter months because of seasonal precipitation and lowest throughout the late summer dry season.

Surface water runoff within the LDW drainage basin also contributes to flow to the LDW, including sources such as storm drains, tributary creeks, CSOs, and non-point inputs. These sources are expected to be less than 1 percent of the total discharge, even during peak flow events (Windward 2010), and will be affected by the magnitude and duration of the runoff input and river discharge and tidal elevations. Two main tributary creeks drain into the LDW: Hamm Creek at approximately river mile (RM) 4.2 upstream from the RAB and Puget Creek at approximately RM 0.7 downstream from the RAB.

A number of parties have measured current velocities within the LDW as part of numerous environmental investigations (Harper-Owes 1983; King County 1999; Prych et al. 1976; Santos and Stoner 1972; Stevens, Thompson, and Runyan 1972; Weston 1993). The most extensive measurements within the LDW were collected by King County in 1996. The measurements were made at two locations in the LDW (RM 1.1 and RM 3.5) for a 3-month period beginning in August 1996 and recorded currents at 15-minute intervals along a vertical profile (King County 1999). The RM 3.5 deployment station is just downstream from the RAB; therefore, it provides a measure of anticipated velocities within the vicinity of the RAB. Measured current velocities during this study rarely exceeded 1.3 feet per second.

Further details on the surface water hydrology for the LDW are described in detail in the LDW Final RI (Windward 2010).

3.2.6 Sea-Level Rise

A potential rise in mean sea-level was considered as part of the design process, as requested by EPA. Mean sea level is projected to rise by 6.5 inches by 2050 for the state of Washington with a range of -1 to 19 inches (National Research Council 2012). This would result in a future predicted MHHW elevation of 11.6 feet MLLW (in comparison to the current MHHW elevation of 11.1 feet based on MLLW defined by the current tidal epoch). It is expected that sea level will rise gradually over time. An increase in mean sea level will correspond to a likewise increase in design water levels at the site. This will result in a minor reduction of bottom currents due to both river/tidal currents and prop wash velocities. This decrease in bottom currents will result in a reduction in shear stress induced on the sea bed (given that all other design criteria remain the same). Therefore, the projected increase in mean sea level is not anticipated to impact the hydraulic stability of the backfill and shoreline containment design within the RAB.

3.2.7 Navigational Uses

Navigation that occurs within and adjacent to the RAB is mainly associated with commercial vessel activities within the federal navigation channel, although recreational vessels do frequent the LDW in the vicinity of the RAB.

An analysis of vessel traffic presented in *the Draft Final Feasibility Study: Lower Duwamish Waterway* (AECOM 2010) attempted to quantify vessel traffic within the LDW. However, the evaluation focused on larger vessel traffic as it was conducted based on the number of times bridges spanning the LDW are opened on an annual basis. The results of the study indicate:

- 35 to 40 percent of the larger vessel traffic continues upstream at least as far as the South Park Bridge at RM2.0 (the RAB is located at approximately RM 3.6)

- Tug traffic occurs two to five times per week
- Yachts ranging from 100 to 160 feet in length travel to and from Delta Marine, located at RM 4.2 (upstream of the RAB)

3.2.8 Ecosystem Considerations

This section provides a brief overview of the habitat likely to be affected near the RAB:

- **Biota**:
  - The dominant benthic macrofauna included nematodes, oligochaetes, the gammarid amphipod *Corophium spp*., the cumacean *Leucon sp*., the polychaetes *Manayunkia aesturina* and *Hobsonia florida*, and several species in the family *Spionidae*.
  - The bivalve *Macoma spp*.
  - The benthic meiofauna (smaller marine organisms) community is dominated by harpacticoid copepods and nematode worms (Cordell et al. 1994, 1996).
- **Shellfish**: includes clams (mostly *Macoma balthica*, and occasionally *Macoma spp.* and *Mya arenaria)*, crabs (slender crab [*Cancer gracilis*] and Dungeness crab [*Cancer magister*]), shrimp, and mussels.
- **Salmonids**: species include Chinook salmon *(Oncorhynchus tshawytscha),* coho salmon *(Oncorhynchus kisutch),* chum salmon (*Oncorhynchus keta),* pink salmon *(Oncorhynchus gorbuscha),* steelhead trout *(Oncorhynchus mykiss),* cutthroat trout *(Oncorhynchus clarkiclarki)*
  - Note: to protect listed salmonid species, timing for in-water construction work (for example, dredging, backfilling, and habit placement) in the LDW typically extends annually from October 1 to February 15 (the USACE work window). However, the NMFS and USFWS have allowed work to start August 1, 2013.
- **Non-salmonid Fish**: includes shiner surfperch *(Cymatogaster aggregata),* snake prickleback*(Lumpenus sagitta),* Pacific sandlance*(Polygonella myriophylla),* Pacific staghornsculpin*(Leptocottus armatus),* longfin smelt *(Spirinchus thaleichthys),* English sole (*Pleuronectes vetulus),* juvenile Pacific tomcod *(Microgadus proximus),* pile perch (*Damalichthys vacca),* rock sole (*Lepidopsetta bilineata),* surf smelt

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(Hypomesus pretiosus), three-spined stickleback (*Gasterosteus aculeatus),* Pacific herring (*Clupea herengus pallasii),* Starry flounder (*Platichthys stellatus)*

- **Wildlife**:
  - Bird species likely include great blue heron (*Ardea herodias*), killdeer *(Charadrius vociferus),* Canada geese *(Branta canadensis),* belted kingfishers *(Megaceryle alcyon),* spotted sandpipers *(Actitis macularius),* European starlings (*Sturnus vulgaris),* and a variety of gull species, swallows, sparrows, finches, rock doves, crows.
    - Bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrines*), and osprey (*Pandion haliaetus*) have been observed along the LDW
  - Aquatic species include a variety of ducks, including mallards, gadwall, scoters, goldeneyes, and scaup.
    - Pigeon guillemots, mergansers, grebes, and cormorants may feed on small fish (Cordell et al. 1996; USACE et al. 1994; Weston 1996)
  - Mammals include rabbits, opossums, mice, shrews, moles, bats, squirrels, muskrats, raccoons, seals, and otters.
  - Terrestrial mammals are likely not present due to the highly developed land use surrounding the project site.
- **Threatened and Endangered Species**: 19 fish and wildlife species observed in the LDW are listed under the ESA and/or by Washington Department of Fish and Wildlife (WDFW) as threatened, endangered, candidate species, or species of concern. Except for Chinook salmon, coho salmon, bull trout, bald eagle, western grebe *(Aechmophorus occidentalis)*, and perhaps Pacific herring, use of the LDW by these listed species is rare or incidental (Windward 2003).

A comprehensive summary of the various habitats identified near the RAB and potential uses by these benthic invertebrates, fish, and wildlife and impacts is presented in the Final EE/CA (Anchor QEA 2011a).

3.3 Soil and Sediment Environmental Characterization

3.3.1 Historical Sampling

The sediments within the RAB have been characterized during a number of investigations, most recently by Boeing (MCS 2004), the Owner (Anchor and Farallon 2006), a joint effort by USACE and EPA (Herrera and USACE 2008), and EPA (Windward 2007a, 2007b). The Lower Duwamish Waterway Group compiled the sediment quality information into a single database to ensure all parties have access to and use the same data set for sediment quality evaluations. This database was used for the data summary and evaluations presented in the Final EE/CA (Anchor QEA 2011a).

A detailed summary of the sampling density for each of the SMS analytes and exceedances of the associated SQS and CSL criteria are summarized in Section 2.4 of the Final EE/CA. The analytical results detected concentrations of PCBs, metals, and semivolatile organic compounds (SVOCs) in sediments and/or shoreline bank soils above the SQS criteria within the RAB. Total PCB SQS exceedances were identified in surface and subsurface sediment over a wide range, both vertically and horizontally. Additionally, all identified surface and subsurface SQS exceedances for the full range of SMS analytes were co-located with total PCB SQS exceedances. Only two subsurface samples contained SQS exceedances for non-PCB chemicals (arsenic, lead, and zinc) and they were co-located with PCB SQS exceedances.

3.3.2 Results of 2011 Additional Sampling

As was discussed in the *Work Plan Memorandum* dated February 8, 2011 (Anchor QEA 2011b), additional subsurface sediment sampling was performed in the RAB to:1) identify the complete vertical exceedances of the total PCB RvAL (12 mg/kg-OC) in subsurface sampling locations that were previously vertically unbounded within the RAB; 2) provide some additional lateral and vertical characterization of total PCBs within the RAB; and 3) to provide some additional lateral and vertical characterization of total PCBs within the Boeing DSOA directly adjacent to the in-water cleanup boundary with the RAB. If the TOC concentration of the sediment sample was less than 0.5 percent or greater than 3 percent, then an alternate RvAL was defined as the total PCB lowest apparent effects threshold (LAET) criteria of 0.13 mg/kg dry weight.

Sample results are summarized in Table 1 and depicted on Figure 6. Appendix A contains the core collection and processing forms, the chain-of-custody forms, the sample results summary forms, and the data validation reports.

Sixteen sediment cores were collected as outlined in the Work Plan Memorandum (Anchor QEA 2011b) and two additional cores were later collected to provide additional spatial resolution of the total PCB RvAL exceedances. The proposed and actual station locations for these cores are provided in Table 2 along with the mudline elevations and total core lengths processed. Station locations and sample results are depicted on Figure 6. The core samples were collected using a vibracore sampling device deployed from a Marine Sampling Services (MSS) vessel. All cores were driven to 14 feet or to refusal. All collected cores achieved at least 75 percent recovery, with the exception of the core collected at station JVE-02. Two cores were collected at this station and the second core was retained. The recovery of this core was the greater of the two at 72 percent.

The core samples were processed and logged as described in the Work Plan Memorandum (Anchor QEA 2011b). Cores were subsampled in one-foot intervals and total solids, TOC, and PCB analyses were initiated following a tiered approach. The approach targeted the identification of the deepest depth of total PCBs RvAL exceedance in each core. Analyses of the deeper intervals of each core were initially analyzed and the shallower intervals were archived pending results of the deeper intervals. If the deeper interval total PCB concentration was less than the RvAL criteria, the next shallowest 1-foot interval in the core was triggered for analysis. This tiered analysis approach continued until the total PCB concentration exceeded the RvAL criteria or the 0- to 1-foot interval was analyzed.

The full subsurface depth of total PCB RvAL exceedances was identified in the previously unbounded core locations. The updated data set was used to refine the target removal depths for the EPA-approved Alternative 4 identified in the Final EE/CA (Anchor QEA 2011a) to remove the full vertical lateral and vertical extents of total PCB RvAL exceedances within the RAB.

4 DREDGE PLAN

The Final EE/CA (Anchor QEA 2011a) selected dredging as a major part of the removal action. This section describes the project constraints and related design considerations that affect the dredge plan design.

4.1 Design Considerations

The development of the dredge plan takes into consideration technical feasibility and RAB restrictions that may affect the ability to meet the project RAOs discussed in Section 2.1.1. Important design considerations include Facility security and access procedures, physical constraints, equipment selection, and dredging performance criteria and associated dredging BMPs.

Jorgensen Forge's security procedures require that all visitors to the Facility comply with a Visitor Security Plan in accordance with the security requirements imposed by Jorgensen Forge's contracts with the U.S. Navy, U.S. Navy suppliers, and other defense-related firms. The Visitor Security Plan establishes specific requirements for visitor security and access to the Facility. Jorgensen Forge also requires that all visitors have the appropriate safety training for the work they will perform and are citizens of the United States. All non-U.S. citizens must be escorted at all times. A chain-link fence secures the entire western boundary of the Facility adjacent to the RAB. The removal action will require reconfiguration of the shoreline bank east of this fence, so the fence will need to be relocated further east. In accordance with the Visitor Security Plan, Jorgensen Forge requires that a fence be maintained and secured during completion of the removal action activities to restrict access to individuals with the appropriate security clearance and safety training. Any ingress or egress through this fence or the main access gate will require clearance by a security guard and possession of a visitor badge. Jorgensen Forge will provide the necessary safety training for all visitors that will enter the Facility through this fence or the main access gate on the eastern portion of the Facility. Visitors must don the appropriate safety gear (as communicated during the safety training) during their access on the Facility.

Key physical constraints include the federal navigation channel located to the west of the RAB, the steep shoreline bank to the east, and the sheet pile and concrete panel walls in the southeast portion of the RAB (see Figure 4). The uplands portion of the Facility must be protected and preserved as much as possible to minimize potential impacts to ongoing operations at the Facility.

Equipment selection and productivity must be considered in the design such that the removal action is completed in an efficient manner that is compatible with RAB constraints, minimizes over-excavation in the RAB, and produces a material that is compatible with the transport and offsite disposal methods.

Dredging performance criteria are designed to limit the concentrations of PCBs in the LDW water column due to dredging operations. Dredging and excavation of sediments cannot avoid the resuspension of sediments; however, specific methods and BMPs that, in combination, support the project objective of completing the removal action in a timely manner while reducing the suspension and release of sediments. The BMPs discussed in the next section and detailed in Appendix E of the Final EE/CA (Anchor QEA 2011a) support the following performance criteria:

- **Residuals** –Remove the targeted sediment using environmental dredging methods that are specifically designed to limit (not avoid) the formation of dredging-generated residuals on the bed of the LDW, thereby limiting sediment resuspension and release to the water column.
- **Water Quality** –Remove the targeted sediment using environmental dredging methods and BMPs that are specifically designed to limit suspension of sediments into the water column, thereby limiting impacts to water quality during the removal action.
- **Productivity** – Remove the targeted sediment in an efficient manner that is compatible with the RAB constraints, limits excess removal of non-targeted sediment, produces a material that is compatible with delivery by truck and/or rail to a Subtitle D landfill in eastern Washington or eastern Oregon, and maintains removal productivity at a level that would allow the dredging to be completed in one season.

4.2 Removal Action Dredging BMPs

Appendix E of the Final EE/CA (Anchor QEA 2011a) detailed specific removal action BMPs to reduce suspension of sediment into the water column while maintaining productivity. This information is reproduced in the following subsections.

4.2.1 Depth of Contamination

This BMP involves the following actions:

- Develop an accurate model for depth of contamination (DoC).
- Use the results of the completed sediment coring program, in combination with geospatial analysis, to develop an accurate DoC to be removed during dredging.

The purpose of accurately measuring DoC elevation is to accurately characterize the extent of the target material with a high degree of confidence for input into the dredge plan.

4.2.2 Design Dredge Elevation

This BMP involves the following action:

- Use the DoC findings, plus an allowance for dredge accuracy and tolerance, to develop an accurate design for dredge elevations.

The purpose of accurately measuring the design dredge elevation is to develop a dredging plan with a high degree of confidence that the target material will be removed efficiently in a single dredging event. The design dredge elevation was set at the DoC elevation with a non-paid overdredge allowance of 2 feet to account for the vertical tolerance of a precision excavator dredge.

4.2.3 Single Dredging Event

This BMP involves the following action:

- Perform dredging to the design dredge elevation in a single dredge event, as verified by periodic bathymetric surveys.

Performing a single dredging event relies on implementation of the design dredge elevation BMP, so that each subunit can be dredged to the required elevation, verified with bathymetric surveys, and then as soon as practical within the operational efficiency of the project place of a minimum 3-inch to 6-inch thick lift of clean backfill material over the dredge subunit. Post-dredge surface samples may be collected before or after placement of the clean back fill material, as described in the Construction Quality Assurance Plan (CQAP; Appendix D). This BMP also allows the dredged area to be quickly covered, reducing the potential for ongoing resuspension and release from the loosened residual sediment.

4.2.4 Sand Cover

This BMP involves the following actions:

- Place a clean sand cover (3 to 6 inches) over dredge cuts in each subunit of the RAB in a timely manner, as soon as practical, after dredging of the subunit is complete.
  - This placement will limit the potential for resuspension and release of sediment from the loosened post-dredging residual material.
- Phase additional backfilling, as appropriate, once all upstream and adjacent dredging is complete.
- The final layer of backfill within the RAB will be placed to the final target grade after all dredging is complete.

4.2.5 Dredging Equipment

This BMP involves the following action:

- Select the appropriate dredging equipment (excavator or derrick) based on the RAB conditions and accuracy requirements.

EPA directed the use of an excavator (also known as an articulated fixed-arm dredge) with a closed environmental bucket as the primary dredging equipment for the removal action (EPA 2011c). Appendix E of the Final EE/CA (Anchor QEA 2011a) describes that in areas where an excavator with an enclosed bucket is unable to remove the encountered materials due to the physical characteristics (e.g., material is too stiff, large debris, pilings, etc.), a conventional derrick with clamshell, grapple, or vibratory hammer will be used.

4.2.6 Dredging Bucket

This BMP involves the following actions:

- Use an enclosed environmental type bucket to limit sediment loss to the extent possible.
- A standard clamshell bucket may be required for denser sediments and debris removal.

Larger debris that have been identified in the RAB, such as trees, large concrete blocks, intact and broken pilings, and molten debris piles, are likely beyond the lifting capacity of this type of bucket. In areas where a closed environmental bucket is unable to remove the encountered material, a heavier bucket with digging capabilities or a conventional wire-supported clamshell dredge, or grapple would be required. Use of an enclosed bucket may limit the loss of sediment from the bucket to the water column, depending on the amount of debris encountered. Limiting loss from the bucket limits the resuspension and release from dredging. The use of other heavy-duty equipment during hard material and debris removal may include an open bucket.

4.2.7 Dredge Bucket Positioning

This BMP involves the following action:

- Use sub-foot accuracy GPS for accurate bucket positioning.

Using on-board Real Time Kinetic (RTK) GPS digital equipment capable of displaying the location of the dredge bucket within 4 to 6 inches horizontally and vertically helps to assured that the target material is captured by the dredge.

4.2.8 Dredge Cuts on Slopes

This BMP involves the following action:

- Implement stair-step dredge cuts for steeper slopes to reduce sloughing of sediment.
- Dredge from the top of the slope downward.

Implementing stair-step dredge cuts limits the bank sloughing that can occur with deep vertical cuts into the sediment (referred to as "box cuts"). Dredge cuts that extend several feet vertically into the sediment bed will eventually slough to a flatter and more stable slope. The sloughed sediment will be remolded with water, and come to rest on the bed as a lower density, higher water content, and lower strength generated residual that is more easily eroded and suspended than native intact sediment. Stair stepping the dredge cuts helps to reduce the formation of generated residuals and reduces the potential for resuspension and release. In addition, slopes will be excavated from the top down to avoid raveling and sloughing.

4.2.9 Piling Removal

This BMP includes removal of piling in a manner that minimizes the release of sediment. Piling removal will require conventional marine construction equipment, such as a derrick configured with pile-pulling and heavy lifting equipment. If a vibratory hammer is used, care shall be taken not to destabilize slopes and/or banks. If individual pilings cannot be removed, then they will be cut off at the sediment/soil excavation surface or at least 3 feet below the final grade, whichever is deeper.

4.2.10 Dredge Slopes with Excavator

This BMP involves the following action:

- Use an excavator dredge, as appropriate, for improved bucket control on steeper slopes.

The purpose of dredging steeper slopes using an excavator, as opposed to a cable-deployed bucket, is to limit the disturbance of impacted sediment on the slope during dredging, and in turn limit resuspension and release. A cable-deployed bucket from a conventional derrick or crane barge can tip and slide down slope as the bucket engages the inclined face of submerged steep slope. Also, a cable-deployed bucket is like a pendulum and the positioning of a swinging bucket can be difficult to accurately track. Alternatively, a bucket deployed on the fixed arm of an excavator can be held in place at a known location and elevation on the slope while the bucket is closed, reducing the disturbance of the sediment on the slope.

4.2.11 Water Management

This BMP involves the following action:

- Prohibit direct overflow of water in sediment haul barges back to the LDW without prior processing and management as dredging return water.
- Manage and remove upland stockpile water that comes in contact with stockpiled material.

The purpose of the water management is to stop the release of sediment and associated contaminants back into the LDW from the sediment haul barge.

The material placed in a barge by an environmental mechanical dredge using an enclosed bucket consists of both sediment and water, since the bucket is not 100 percent full of sediment and water is not allowed to drain from the bucket. During precision environmental dredging projects, the dredging bucket may be only half-full of sediment on average over the course of the project due to relatively thin cuts intended to avoid removal of non-impacted sediment and to avoid over-penetration of the bucket, with water filling the other half of the bucket. The volume of water placed in the barges for an environmental dredging project can therefore equal the volume of sediment dredged from the LDW. Thus, a 20,000-cubic yard (cy) dredging project can result in that volume of sediment placed into barges plus another 20,000 cy of water. This is consistent with the volume of water collected with the equipment at Boeing Plant 2 where approximately 140 gallons of water were collected for every 1 cy of sediment dredged. Failure to manage the water in the barge during dredging can result in the release of turbid water back into the dredged area with the potential for increased sediment resuspension, release, and additional generated residuals.

Implementation of the barge water management BMP for the removal action will involve the active pumping of the excess water from the sediment haul barges and may include the addition of dewatering agent (for example, Portland cement, lime kiln dust, or diatomaceous earth) to limit the amount of ponded water within the barge and preventing direct overflow from the barge back to the LDW. Any removed water would be pumped to a water management system designed to remove excess sediment and associated contaminants prior to discharge of the treated dredge return water back to the work area within the LDW (in accordance with the appropriate permits). The water management system will be contained on a barge similar to the system employed for the Slip 4 EAA removal action.

The water management system used to process the dredge water will utilize all known and reasonable technologies prior to discharging the water back to the LDW to achieve the applicable permit-specified limits at the in-water points of compliance. A barge system may include pumping water from the sediment barge to a designated water management barge (e.g., flexi-float or flat deck barge), into storage and settling tanks or other methods to filter out suspended particles, processing the water by filtration (e.g., filters and/or activated carbon filters) to remove additional suspended particles and dissolved organic constituents, and discharging the water back to the LDW within the active work area. An onshore water management system similar to that being used for the Boeing DSOA cleanup may include pumping the water from the sediment barge to the onshore system, removing large particles and suspended solids, followed by filtration (e.g., sand filters and/or activated carbon filtration) to remove additional suspended particles and dissolved organic constituents prior to discharge back to the LDW within the active work area. The chemical parameters and frequency of sampling will be defined in the Water Quality Monitoring Plan (WQMP; Appendix E).

This BMP also includes the use of upland stockpiling management procedures to contain excavated shoreline soils within stockpile areas such that transport of stockpiled soils and water that comes into contact with stockpiled material to the LDW does not occur. Stockpiles will be surrounded by Ecology blocks, lined with an impervious material, and protected from weather and disturbances by an impervious covering when stockpiling is not occurring. Upland project water that contacts contaminated stockpiled soil and runoff from the stockpile to adjacent areas will be managed, collected, treated and/or disposed.

4.2.12 Intertidal Sediment and Shoreline Bank Soil Removal

This BMP involves the following action:

- Conduct intertidal sediment and shoreline bank soil excavation “in the dry” to the degree reasonably possible using land-based equipment.

Intertidal sediment and shoreline bank soil excavation "in the dry" reduces the potential for release of impacted intertidal sediment and shoreline bank soils to the LDW by removing the sediment accessible from the upland when the tides are out and the sediment is exposed. The work is best done during daylight hours during very low tides, which occur only during May through August of each year. Alternatively, low tides during the in-water construction window occur during night hours.

This BMP includes the use of shoreline-based excavation equipment that is working at least 2 feet back from the actual water line at all times. When and where possible, the shoreline excavation will be completed prior to dredging as the in-water removal activities proceed generally from upstream to downstream. Excavation and dredging from upslope to down slope will reduce slope failures that can resuspend sediment and will enable capturing any material that moves down slope during shoreline excavation work. Additional measures to minimize potential erosion in the intertidal zone will include removing large pieces debris remaining on the surface and using the excavator bucket or similar equipment to compact the newly excavated surface during periods when shoreline excavation is not being conducted. A Temporary Erosion and Sedimentation Control (TESC) fence will also be required during shoreline excavation.

4.3 Dredge Prism Design

The layout of the dredge plan is based on design removal grades, equipment capabilities, anticipated equipment size, and existing topography. The dredge prism design supports the removal of the horizontal and vertical extents of total PCB RvAL exceedances within the RAB and includes removal depths ranging from 1 to 11 feet below mudline.

The dredge prism design was refined from what was identified in the Final EE/CA (Anchor QEA 2011a), to more precisely remove total PCB RvAL exceedances. The sediment management units (SMUs) presented in the Final EE/CA were developed to roughly approximate areas with consistent removal depths based on existing sediment core data. This approximation allowed consistent evaluation of removal areas, volumes, and costs across the removal action alternatives to support selection of the preferred alternative (Alternative 4 presented in this BODR). In this BODR, the SMUs were converted to Thiessen polygons. Thiessen polygons are commonly used to define representative areas surrounding point data and are developed by connecting the equidistant midpoint of a single core to all surrounding cores. A dredge prism design was then developed to remove total PCB RvAL exceedances represented by each irregularly shaped Thiessen polygon. Due to variable slopes and constructability issues, the removal depths were often deeper than the total PCB RvAL exceedances in each Thiessen polygon (see Figures 9a, 9b, and 9c).

The following subsections describe the in-water and shoreline bank dredge prism design.

4.3.1 In-Water Dredging

Existing sediment chemistry data were used to develop a DoC surface that represents the deepest vertical extent of total PCB RvAL exceedances throughout the RAB. Thiessen polygons were generated around each core location (if two cores were approximately co-located the more recent data was used for design) collected during the additional design characterization 2011 sediment sampling (see Section 3.3.2) and previous sediment sampling programs. The deepest PCB RvAL exceedance in each core defined the necessary removal depth and the dredge design was developed to remove that depth (at a minimum) across the associated core Thiessen polygon area. Conservative adjustments to removal depths (i.e., changing shallow removal depths to deeper depths) were made to six polygons. The removal depths in the Thiessen polygons representing SD-212 and SD-214 were increased from 2 feet to 6 feet because only limited subsurface total PCB data were available at these locations and it was considered likely the total PCB RvAL exceedance depth would be equivalent that shown in the directly adjacent JVE-216 core. The removal depth in Thiessen polygons representing JVE-07, JVE-210, JVE-215, and SD-209 were increased from no dredging to 1 foot to achieve a minimum 1-foot removal in these areas (with an additional 2-foot non-paid overdredge allowance).

The required minimum removal depth in each Thiessen polygon is shown in Figure 7 and represents the target removal action dredge surface. This surface is also known as the contaminated "neatline" surface which can be used to specify the minimum required depth of removal to a dredging contractor (the Contractor). In addition to removing the contaminated "neatline" surface, the Contractor will also be working with a specified "overdredge allowance" to account for equipment tolerances. The development of a contaminated surface is used to establish the required dredging elevations and optimize the overall dredge plan design.

The design process converts the target removal action surface based on Thiessen polygons into a dredge plan consisting of a constructible mosaic of rectilinear dredging units with constant elevation or constant slope. In order to remove the irregular depths identified in the Thiessen polygons while maintaining constructability, in many areas the design dredge surface removes additional materials below the required depths. The following general steps summarize the dredge plan design process:

- Define the contaminated "neatline" surface to be dredged (discussed previously) based on the DoC.
- Define the type(s) of dredging equipment to be used. The type and size of dredging equipment (along with ancillary equipment) may influence the design of the dredge prism.
- Identify the allowable overdredge to be applied to the dredge prism. Allowable overdredge accounts for equipment tolerance, and payment or no payment for allowable overdredge can be used as a control to limit the Contractor from significant overdredging.
- Identify RAB restrictions that modify the dredge prism. RAB restrictions may include accessibility, predominant direction of dredging, and structural and/or slope setbacks due to unstable slopes and structures.

Figure 8 depicts the dredge plan based on following the above steps. This dredge plan achieves removal to the contaminated "neatline" surface throughout the RAB. The dredge prism is comprised of two components: the required dredge prism and the allowable overdredge. The required dredge prism represents the elevation, grades, and horizontal extent that the Contractor will be required to remove. The allowable overdredge is a constant thickness of sediment below the required dredge prism that design engineers typically allow (and the Contractor is typically paid for) to account for dredging equipment accuracy and tolerances. Specifically, in order to achieve a required elevation or grade, the dredge ends up removing excess material below the required dredge prism. For this removal action, the non-paid overdredge allowance is 2 feet.

To ensure the dredge plan removed the full extents of the required Thiessen polygon depths, a comparison between the dredge plan and Thiessen polygon surfaces was completed. To illustrate comparison of the two surfaces, five cross sections were cut through the RAB extending from the toe of slope in the intertidal area to the edge of the navigation channel in the subtidal area. In each cross section, the existing mudline, the minimum required Thiessen polygon removal depth, the dredge design surface, and the maximum allowable overdredge surface were overlaid. The results of this evaluation are shown in Figures 9a through 9d. These figures show that throughout the RAB the minimum required Thiessen polygon removal depth is achieved and many areas the dredge design, without application of the overdredge tolerance, result in feet of additional removal beyond the required depth.

4.3.2 Shoreline Bank Excavation

The shoreline bank excavation is proposed to occur over a total distance of approximately 570 linear feet, extending from the downriver side of the sheetpile wall to approximately the Facility/Boeing Plant 2 property line (Figure 4). The proposed bank excavation extends from the top of the existing bank from approximately +19 feet MLLW to -5 to -8 feet MLLW. The lower elevation range was selected based on tidal variations and the reach length of typical long-reach excavators. The design excavation would reconfigure the slope to a flatter, more stable 2H:1V slope shoreward of the existing ground surface approximately from the toe of slope upwards to a location that is no closer than 5 feet to any foundation (Figure 8) . The preferred method for these activities will be to attempt to conduct excavation occurring in this range of elevations during low tides to facilitate doing this work "in the dry" from the land side. An estimated 55 to 65 piles (roughly 50 to 60 tons of piles) and debris would be removed and disposed of off-site at a permitted Subtitle D landfill.

As described in Section 2.2.2.1, Jorgensen Forge and Boeing are currently coordinating with EPA to perform a limited soil and CMP removal action along the northwest corner of the pipe where the property line pipes discharge (Figure 3). To support this removal, a sheetpile wall will be installed at approximately the mean higher high water line along the northwest shoreline of the RAB (Figure 3). The shoreline bank sediment and soil quality directly waterside of the sheetpile wall is currently unknown but will be characterized as part of the upland removal action. This data will support whether additional removal waterside of the sheetpile wall will be required below the design grades identified in this BODR by the in-water contractor. There is a potential that total PCB concentrations greater than 50 mg/kg could be identified during this characterization, which would require disposal of this material in a hazardous waste landfill (see Section 4.7.3). This removal would occur directly adjacent to the sheetpile wall so the in-water contractor would need to take the necessary precautions to not impact the structure and coordinate as necessary with the upland contractor to facilitate completion of this work.

4.4 Quantities

The in-waterway dredging would result in the required removal of approximately 10,800 cy. The shoreline bank excavation would result in the required removal of approximately 5,400 cy of impacted soil/fill and sediment, debris, and other encountered material and would create intertidal habitat.

The total amount of sediments actually removed will be measured by computing the difference in volume between the bottom surface as shown by the soundings of the pre-dredge survey and the bottom surface as shown by the soundings of the post-dredge survey. This volume will be used to calculate the volume of sediment that was dredged by the Contractor (and will be paid for if above the required dredge lines and elevations) and the volume of sediment disposed off site.

4.5 Potential Impacts to Adjacent Slopes, Structures, Navigation

Dredging will take place at the base of, and on, existing side slopes along the LDW adjacent to the Facility. Debris (e.g., asphalt, creosote-treated timbers, and piles) are present in intertidal sediments and along the shoreline bank and will be removed. Slope stability will be maintained by dredging to stable slope angles, and backfilling the dredged area to increase the long-term stability of the slopes.

There are several structures along the southern shoreline (i.e., sheet pile wall and a concrete panel walls) that will be near dredging operations and removal directly adjacent to these structures is prohibited to adequately protect their structural integrity. The dredge plan has been designed to mitigate potential impacts on these structures by requiring setbacks from these structures a distance of 5 feet to minimize for potential instability.

The pre-dredging and post-dredging stability of slopes and existing structures was evaluated and is presented in Appendix C using the geotechnical data presented in Section 3.2.1. This includes core logs from the LDW, and borings completed on the Facility uplands.

The dredge plan intends to maintain current navigational access once the dredging, including backfilling, is complete. During the dredge process, navigational access may be restricted, but that can be mitigated through notices to mariners and via radio communications with the U.S. Coast Guard's (USCG's) Seattle Traffic (VHF channel 14).

4.6 Equipment Considerations

As discussed in Section 4.2.5, EPA has required (EPA 2011c) that sediments be dredged using a barge-mounted hydraulic excavator (e.g., fixed arm) equipped with an articulating closed dredge bucket with a hydraulic closing mechanism, as outlined in Appendix E to the removal action EE/CA. It is anticipated that a 4 to 6 cy size dredge bucket will be used for dredging given the size of the project and requirements for shoreline bank dredging. The Contractor will be required to have an enclosed environmental bucket mounted on the excavator available and to use this equipment to the extent practicable recognizing that the shoreline bank is heavily armored with debris. In areas that contain small to larger debris (e.g., heavy vegetation, rock and concrete slabs, intact and broken pilings, and molten debris piles) or harder sediment, this type of equipment is anticipated to be ineffective as debris limits the ability to use an environmental bucket; therefore, a heavier bucket with digging capabilities or a conventional wire-supported clamshell dredge bucket, grapple, or vibratory hammer would likely be the equipment required and selected by the Contractor. Sediments will be loaded into haul barges for dewatering and transportation to an offsite rehandling facility for transport to an off-site, Subtitle D landfill for disposal. As noted in Section 4.3.2, there is a potential that total PCB concentrations greater than 50 mg/kg could be identified during future characterization adjacent to the planned sheetpile wall, which would require disposal of this material in a hazardous waste landfill (see Section 4.7.3).

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Land-based excavation using excavators, backhoes, and other conventional earth moving equipment may be used to remove the shoreline bank materials. Excavation in these areas may be coordinated “in the dry” during periods of low tidal elevations. Given the geometry of the shoreline and the typical reach of upland equipment, it is anticipated that materials removed from the shoreline bank area would be placed into an upland stockpile area or directly into trucks. The stockpiled materials would either be later rehandled into lined trucks or haul barges and transloaded onto railcars for transport to an off-site, Subtitle D landfill for disposal.

4.7 Sediment Handling, Transportation and Disposal

4.7.1 Initial Handling

While dredging and loading the haul barge, the dredge operator will minimize entrained water during dredging. Some typical methods include: 1) properly sizing and operating the clamshell bucket to obtain full buckets for the planned cut; 2) avoiding multiple grabs or stockpiling on the bottom (which results in slurry); and 3) pausing at the water surface to allow free water to escape as needed prior to placement on the haul barge. Barges will be filled to capacity or less; no overflow of the barge will be allowed.

4.7.2 Transport

There are two possible types of haul barges, flat-bottom (including flat-deck barges with watertight sidewalls) and split-hull. If split-hull barges are used, they will remain sealed at all times. The ponded water on the haul barges will be collected and treated as necessary to maintain compliance with the 401 Water Quality Memorandum and pumped off of the barge to avoid barge overflow as described in the water management BMP in Section 4.2.10.

In general, dredged sediment will be loaded into haul barges and taken to a transloading facility, where the material will be transferred from the barges to trucks or rail cars for transportation to disposal facilities. The material will be unloaded from the barges using a rehandling bucket and placed in 20 foot intermodal shipping containers or gondolas lined with durable (e.g., 8-millimeter [mm] thick) plastic sheets. The haul route from the RAB to the off-site landfill for disposal, including the locations of any transloading facilities, will be determined by the Contractor and defined in the Removal Action Work Plan (RAWP).

Spillage or direct discharge of sediments into the receiving water will not be permitted during transfer of the sediment from the barge. The Contractor will be required to specify method(s) to control sediment loss as part of the Dredging and Disposal Plan and Contractor Quality Control Plan. A potential prevention method may include use of a spill apron or plate between the barge and shore to collect any dripping or spillage and direct it back into the barge or onto the shore. The containers will either be staged on railcars at the offload facility or trucked to an intermodal facility and placed on railcars for transport to a licensed upland disposal facility. The containers will be lined with plastic and sealed to prevent leakage onto the road or rail bed during transit.

4.7.3 Disposal

Disposal of required dredged and excavated materials will be at a permitted Subtitle D landfill. Two upland regional landfills have established services to receive dredged contaminated sediments: Roosevelt Regional Landfill near Goldendale, Washington, and Columbia Ridge Landfill near Arlington, Oregon. These sites are licensed as RCRA Subtitle D commercial landfills in the states in which they operate, and both have the ability to receive wet dredged sediments delivered to the landfill by rail.

As described in Section 4.3.2, future characterization of the soils directly waterside of the sheetpile wall that will be installed to support the upland property line outfall removal action could potentially result in the identification of total PCB concentrations greater than 50 mg/kg, which would require disposal at a permitted Subtitle C landfill. If this occurred, any of these removed materials would need to be appropriately segregated from materials to be disposed at a Subtitle D landfill. The nearest regional Subtitle C landfill is the Chemical Waste Management Northwest Landfill located in Arlington, Oregon.

The Contractor is expected to be responsible for identifying the landfill, subject to approval by the Owner, and how the materials will be transported, but will be required to provide detailed information in the RAWP that will describe the proposed means and methods. In the RAWP, the Contractor will be required to provide information about the following items:

- Methods and equipment that will be used for excavation and dredging
- Methods and equipment that will be used for transport and hauling of excavated and dredged materials
- Sequence and estimated duration of excavation and dredging activity including anticipated cy of excavated upland soils and marine sediment generated daily
- Means by which limits and cut depths will be checked and verified by the Contractor
- Means for managing excavated and dredged materials and preparing them for transportation
- Disposal locations for excavated and dredged materials, including haul routes and any locations where rehanding or offloading is required, and documentation of the disposal facility acceptance of the waste
- Methods, equipment, and location(s) for establishing temporary stockpiles, including isolation of stockpiled soil from the environment and preventing unfiltered off-flow water from entering adjacent waters
- Means of protecting sediment and soil stockpiles from erosion, wind, and spillage
- Worker safety and protection of the public
- Methods and equipment for survey control
- Methods for shoring and securing trenches and temporary excavations
- Traffic control while performing excavations and backfilling
- Notification and procedures to be used to coordinate with and accommodate marine vessel traffic while dredging
- Marine equipment anchoring locations and procedures

4.7.4 Other Materials Not Requiring Remediation

4.7.4.1 Debris

Debris encountered within the removal action area will be disposed at a Subtitle D landfill. Debris includes all material that is not sediment, including rock. The Contractor will identify the method (or methods) that will be used to remove debris or stockpile it and transport it to a landfill. The Contractor will maintain a daily journal of activity, which shall include description of the debris handled during dredging.

5 BACKFILL PLAN

The purpose for the backfill material is to nominally return the mudline to the original grade and to provide a residual mixing layer in the sediment removal areas. The dredged areas will be backfilled with a volume of backfill material that is approximately the same volume as the dredging volume to restore the riverbed to the pre-dredging elevations except in and within 10 feet of the navigation channel. This 10-foot offset supports maintaining deeper depths in the navigation channel for deeper draft vessels (USACE 2010). The amount of backfill material is estimated to range approximately between 1 and 10 feet thick.

This backfill layer is subject to erosive forces from localized propeller wash from vessels maneuvering within the project remediation area as well as river currents. The intent of the backfill is not to be resistant to every erosive force imported, but to generally remain stable to roughly the grades achieved after construction. Some movement of the material is anticipated.

Appendix B details the evaluation of these potential erosive forces related to evaluation of the backfill material. A summary of the analysis and results is presented herein.

5.1 Propeller Wash

As a vessel passes over an area, the vessel's propellers can impart an erosive force to the mudline surface. This temporary force can cause the backfill and/or armor materials to be suspended and redeposited back in the same general area. Using the methods presented in the EPA's "Armor Layer Design for the Guidance for In-Situ Subaqueous Capping of Contaminated Sediment" (Maynord 1998), the stable particle sizes to resist propeller wash for vessels operating in this section of the LDW was evaluated. The selection of the design vessels identified and the operating criteria stated previously was based on previous studies conducted around the RAB, which evaluated vessel traffic within this specific reach of the LDW, primarily AMEC (AMEC and Floyd|Snider 2011) and Lower Duwamish Waterway Group Sediment Transport Analysis Report (QEA 2008). The tugboat *Patricia S* was identified as the vessel with the highest bottom velocity that would operate directly over the backfill placement areas.

Using the guidance presented in Chapter 3 of the EM 110-2-1601 manual (USACE 1994) and modified by Maynord, the resulting stable rock size to protect against the *Patricia S* efflux jet velocity was determined to be a material with a D_{50} of 11 inches (0.9 feet) when the vessel is operating during a low water condition or a material with a D_{50} of 1 inch (0.1 feet) when the tugboat is operating during a high tide.

Subsequently, the estimates of potential surface sediment mixing and scour depths was evaluated for a coarse grain sand (D_{50} = 0.2 mm). The Hamill (1988) method was used to predict this potential mixing depth. For the *Patricia S* design vessel, the potential mixing depths ranged from 1.5- to 2-inches assuming the vessel operates over the backfill for a short time period (2 to 5 minutes). Therefore, the use of a gravelly sand or coarse sand with the proposed backfill placement thickness ranging from 1 to 10 feet would provide a sufficient residual mixing layer and meet the substrate conditions of the existing riverbed.

5.2 River Currents

The expected erosive forces due to LDW currents over the proposed backfill areas were evaluated for typical tidal velocities as well as the 2-year and 100-year return period flows based on information provided in the King County, Washington Flood Insurance Study (FIS) (FEMA 2005), the Sediment Transport Analysis Report (STAR) (Windward and QEA 2008), and Sediment Transport Modeling Report (STM) (QEA 2008).

The 2-year, 10-year and 100-year return-interval flow at the site are 8,400 and 12,000 cfs, respectively. The calculated maximum bottom shear stress for a 100-year storm expected at the project site is 0.06 pounds per square foot (psf) which results in a stable grain size of 6.0 mm (a fine gravel), as summarized in Table 3.

5.3 Backfill Material

Based on the analysis of the erosive forces expected at the RAB, a backfill material consisting of gravelly sand or coarse sand material placed in the dredged areas should remain relatively stable. A finer grained material could be placed in the lower portions of the fill depth as long as a minimum thickness of gravelly sand occurs at the surface.

The backfill material will be sampled at the material source and analyzed at an independent laboratory for physical (Table 4) and chemical analyses (Table 5). A minimum of five samples will be collected at spatially dispersed and representative locations from the quarry that contributes to the final material that meets the geotechnical specifications. The five sub-samples will then be combined to form a single composite sample that will be submitted for physical and chemical analysis. The gradation of the sample must fall within the allowable gradation range summarized in Table 4. The chemical concentrations must be below the EPA-approved (EPA 2011a) backfill levels listed in Table 5 and the material source must be approved by the EPA to ensure the material meets requirements for clean fill. EPA has granted approval of quarry sources for material to be used at Boeing Plant 2 based on existing data (Floyd|Snider 2012; EPA 2012).

Habitat material placed in the intertidal areas on top of shoreline bank armor material is discussed in Section 7.

5.3.1 Quantities

Backfill material placed over the dredge areas to generally return the areas to pre-construction elevations will result in the required placement of approximately 8,000 cy of backfill material.

5.4 Equipment Considerations

It is anticipated that equipment used by the Contractor as described in section 4.6 will also be used to place backfill material. Backfill material will be placed in the dry as much as feasible. The Contractor will be required to place the backfill material in lifts working from the toe of the slope upward in a manner that minimizes disturbance to the dredged surface.

6 SLOPE CONTAINMENT PLAN

The purpose of the shoreline slope containment is to contain the soils and sediments along the shoreline from the LDW and to stabilize the shoreline from future erosion. The shoreline areas are to be excavated and reconfigured and a shoreline armoring layer is proposed to provide protection against erosive processes. The armoring material will be placed on top of a filter layer and a surface layer of habitat material will be placed on top of the armoring material to fill the interstices as discussed in Section 7. Erosive processes likely to impact the shoreline design include waves generated by passing vessels and currents in the river.

Appendix B details the evaluation of these potential erosive forces related to selection of the shoreline armoring material. A summary of the analysis and results is presented herein.

6.1 Vessel-generated Wakes

Vessel-generated waves from vessels transiting along this reach of the LDW were computed using the methods presented in Sorensen (1997). As identified in Section 5, the selection of design vessel criteria was based on previous studies conducted around the RAB.

Predicted vessel-generated wave heights expected to be generated near the RAB ranged from between 0.5 feet to 1.5 feet, with periods of approximately 2 seconds. To compute the stable particle size and shoreline containment cover gradation and thickness to protect the slope from the maximum expected vessel-wake (1.5-foot height, 2-second period), the Automated Coastal Engineering System (ACES) Rubble Mound Revetment Design Module was used. The resulting gradation for the restored 2H:1V shoreline slope includes a D_{50} of 0.4 feet for the armor stone material and a D_{50} of 0.05 feet for the underlying filter layer.

6.2 River Currents

As discussed in Section 3.2.4, the expected erosive forces due to river currents at the RAB was evaluated for a 100-year return period event based on information available in previous studies (described above).

Appendix B details the evaluation of the expected river currents and stone size selection for the shoreline armor stone. A summary of the analysis and results is presented herein.

To determine the stable armor stone sizing required along the shoreline, a depth-average velocity over the entire water column was used to determine the appropriate design velocity. The design velocity for a 100-year event was calculated to be 5.7 feet per second (fps). Using the methods presented in Maynord (1998), the resulting stable particle size for the restored shoreline slope of 2H:1V is 0.9 feet.

6.3 Shoreline Containment Material

6.3.1 Shoreline Armor Layer

Based on the analysis of the erosive forces expected at the site, the 100-year river current event is the dominate force. Riprap with a D_{50} of 0.9 feet is recommended for the shoreline containment material. The armoring should extend to the base of the 2H:1V slope with an anchor toe constructed to support the material.

The Washington State Department of Transportation (WSDOT) material gradation best meeting the shoreline armor layer material requirements is the specification for light loose riprap material (Table 6).

6.3.2 Filter Material Layer

The filter layer material will be placed between the regraded shoreline slope and the placed shoreline armor material to prevent migration of fine soil particles, to distribute the weight of the armor units, to provide more uniform settlement, and to permit relief of hydrostatic pressure within the soils (USACE 1995).

Using guidance presented in Engineer Manual (EM) 1110-2-1614 (USACE 1995), the selected filter layer must also satisfy requirements pertaining to both the armor-to-filter relation as well as filter-to-underlying soil relation.

Table 7 presents the material gradation specification for the proposed filter layer material.

By comparing the existing shoreline sediment characteristics at the RAB (Section 3.2.1) to the shoreline armoring material (Section 6.3.1) and the preferred filter material (Table 7), the filter material is coarse enough to prevent loss through the armor layer and provides sufficient fine material to minimize the loss of underlying soil. This filter material specification meets the range for permeability based on the underlying soil with the exception of locations where coarser grained sediment is present.

The filter material will be uniformly amended with GAC at a minimum content 0.5 percent GAC by dry weight. The activated carbon would likely be mixed with the filter material prior to being brought to the site.

6.3.3 Quantities

Application of the slope containment will result in the placement of approximately 2,500 cy of filter material and 3,800 cy of riprap material over approximately a total of 0.75 acres.

6.4 Equipment Considerations

It is anticipated that equipment used by the Contractor as described in section 4.6 will also be used to place shoreline containment materials. Filter and armor materials will be placed in the dry as much as feasible. The Contractor will be required to place the materials in lifts working from the toe of the slope upward in a manner that minimizes disturbance to the surface below.

6.5 Stormwater Outfalls

As described in Section 2.2.1, outfalls 001 and 002 were inactivated as part of installation of the stormwater treatment system installed in January 2013. The stormwater within the outfall 001 and 002 drainage are now reconveyed through the treatment system and discharged to outfall 003 post-treatment. Concurrent with the dredging and shoreline reconfiguration, a new single outfall will be constructed to replace outfall 003 through the reconfigured bank and discharge into the LDW (Figure 9). As necessary, a trench will be dug along the alignment of the new outfall to facilitate installation below the dredge surface and overlying clean backfill.

The new outfall will be butt-fused 24-inch high-density polyethylene (HDPE) SDR 17 pipe with an outfall invert elevation of approximately -9.5 feet MLLW. A 24-foot by 10-foot dispersion pad will be installed at the outfall pipe discharge location (Figure 9). Concrete ballast will be installed every 7.5 feet between 0 feet MLLW and the invert. Ballast spacing will be increased to every 3.75 feet at 20 feet from the end of the outfall pipe. Buoyancy calculations to account for installation and flotation potential of the new outfall pipe were based on the pipe system being sunk while still containing 20 percent air by volume. Once the outfall pipe has been placed in the trench and filled with water, the factor of safety against flotation is 5.5. Drag and uplift forces on the outfall end of the pipe were also calculated to determine the effects that the LDW current would have on the new outfall. The maximum end of pipe deflections resulting from drag and uplift are 0.02 inches and 0.07 inches, respectively. Buoyancy and end of pipe force calculations are included in Appendix G of the Jorgensen Forge NPDES Engineering Report (Anchor QEA 2012).

7 HABITAT ENHANCEMENTS

Habitat enhancements are incorporated into the removal action design for EPA's selected remedy. Properly functioning estuarine habitat is critical to the survival of salmonids, including Puget Sound Chinook salmon, steelhead, and bull trout that are currently listed as threatened under ESA. The proposed removal action is a fundamental component of improving the estuarine environment of the LDW. In an effort to improve habitat conditions in the LDW and support the recovery of these three ESA-listed species, habitat enhancement activities have been incorporated into the removal action design.

7.1 Shoreline Substrate Enhancement

The following summary describes the substrate modification activities that will be implemented to enhance habitat as part of the removal action.

7.1.1 Design Considerations

Productive communities of epibenthic and infaunal invertebrates are often associated with fine-grained (silt and sand) substrates in the intertidal zone of estuaries (Simenstad 1983). Larger substrate such as gravel and cobble tends to have less productive epibenthic and infaunal communities, while very large substrate such as riprap supports even fewer invertebrates. If smaller substrate fills the riprap interstices over time or by design, more extensive benthic communities may develop. Juvenile salmonids, specifically Chinook salmon, prefer areas with small substrates (sand and gravel) (Tabor, as cited in GLWTC 2001).

In the RAB, sand and gravel substrate will be added to areas with riprap armor within the intertidal area. This substrate mix will fill in the interstitial spaces between the riprap, removing potential hiding places for salmonid predators and provide a uniform habitat substrate that will increase the habitat available for epibenthic and infaunal invertebrates, which are important prey items for juvenile salmonids. The substrate size is not designed to stay in place given the erosive forces expected in the in-water armored areas so some movement and relocation of the material is expected over time.

BMPs identified in Section 4.2 will be followed during the removal action to reduce suspension of sediment into the water column while maintaining ecological community productivity.

7.1.2 Habitat Material Characteristics

Consistent with Section 5.3, the habitat material will be sampled at the material source and analyzed at an independent laboratory for physical and chemical analyses (Table 5). A minimum of five sub-samples will be collected at spatially dispersed and representative locations from the quarry that contributes to the final material that meets the geotechnical specifications. The five sub-samples will then be combined to form a single composite sample that will be submitted for physical and chemical analysis.

The habitat material chemical concentrations must be below the EPA-approved backfill levels (EPA 2011a) listed in Table 5 and the material source must be approved by the EPA to ensure the material meets the requirements for clean fill. EPA has granted approval of quarry sources for material to be used at Boeing Plant 2 based on existing data (Floyd|Snider 2012; EPA 2012).

The habitat material will consist of clean, naturally-occurring round or sub-angular 2.5-inch minus sand and gravel material consistent with other projects within the region. For example, in Commencement Bay, the WDFW and the NMFS specified a sand and gravel (2-inch minus) mixture known as "habitat mix" as the preferred substrate for juvenile salmonids in estuarine habitats during a CERCLA cleanup project in Middle Waterway (Anchor Environmental 2002). The sand and gravel material will be rounded and not angular. Table 8 presents the material gradation specification for the proposed habitat substrate material.

7.1.3 Quantities

A 0.5-foot layer of habitat substrate will be added to all intertidal areas where riprap armor will be placed which will result in the placement of approximately 1,300 cy of habitat substrate.

7.1.4 Equipment Considerations

Habitat substrate material will be placed in a manner and with equipment similar to that described in Section 6.4.

7.2 Riparian Buffer Vegetation Restoration (Optional)

Jorgensen Forge may decide to voluntarily construct (i.e., this work is not required by EPA and is therefore identified as an optional bid item in the Construction Specifications) a 10-foot-wide riparian planting area along the top of shoreline bank adjacent to the post-remediation shoreline. The intent of the planting would be to provide a buffer between the shoreline and the adjacent industrial property with a diverse, native riparian vegetation canopy of trees and shrubs. As the vegetation matures, it would overhang the bank and provide potential habitat enhancements.

The following summary describes the riparian buffer restoration activities that may be implemented to enhance habitat as part of the removal action.

7.2.1 Design Considerations

Salmon need several types of habitats within and around rivers, including adjacent riparian buffer vegetation areas. Restoration of woody riparian vegetation in association with the shoreline substrate improvements will increase habitat functions for fish and wildlife. Habitat functions likely to be improved include water quality, shading and cooling, and insect prey input for rearing juveniles. This type of habitat restoration also provides habitat benefits for other fish, mammals, amphibians, and terrestrial species that utilize riparian habitats in addition to those that would benefit salmon. Dense vegetation would also limit human disturbance of stream habitat.

7.2.2 Proposed Materials and Techniques

The following materials and techniques for the restoration of riparian buffer vegetation would be used:

- The 10-foot-wide planting areas immediately adjacent to the post-remediation shoreline bank beyond the slope would be planted with native riparian and upland vegetation species. These species are native plant species indigenous to the area and adapted to site conditions and proven to be successfully established under challenging conditions. They would also be more adaptable to poor soil conditions, sun exposure and rapid drainage.

- Coniferous trees would be included to provide shade and help moderate temperature throughout the year in the long term.
- The riparian planting would involve preparing the subgrade through rototilling the existing substrate to a depth of 6-inches. A first lift of 6 inches of topsoil would be rototilled into the prepared subgrade. Another 12 inches of topsoil would be placed for a total depth of prepared topsoil between 12 inches minimum at the edges of the planting area and 24 inches along the centerline of the planting strip.
- Log edging would be installed along the perimeter of the planting area to retain the soils placed.
- Plants would be installed in individual plant pits and backfilled with topsoil.
- Planting areas would receive wood chip mulch to retain moisture and suppress weed establishment.

7.2.3 Quantities

A total of 26 trees and 174 shrubs would be installed over approximately 2780 square feet of planting area. Between 12 and 18 inches (minimum and maximum depths) of imported topsoil would be placed in the planting areas forming a low berm. The topsoil would be retained with the help of a continuous log edging along the perimeter of the planting area. A 6-inch layer of the existing surface material would be amended (mixed) with 6 inches of this topsoil. Total placement of topsoil would be 135 cy, with an additional 34 cy of wood chip mulch.

7.2.4 Equipment Considerations

Riparian buffer vegetation restoration materials would be placed and installed utilizing conventional upland equipment (e.g., excavator and manual labor).

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8 SHORT-TERM IMPACTS DURING CONSTRUCTION

This section describes the temporary impacts that are anticipated due to the construction activities.

8.1 Construction Impacts to Adjacent Sediments

To minimize the potential for resuspension of contaminated sediments, BMPs, operational controls, engineering controls, and monitoring requirements have all been specified as part of the design as described in Section 4.1. Collectively, all these elements will greatly reduce any potential for contamination of sediments both upstream and downstream of the RAB.

In addition, pre- and post-remediation perimeter surface sediment samples will be collected to confirm that there are no material increases in concentrations of COCs in surface sediments adjacent to the RAB relative to their pre-remediation concentrations. Detailed sampling methods, sampling station coordinates, and quality control protocols are provided in the CQAP (Appendix D).

A summary of perimeter monitoring methods and objectives is provided in this section.

8.1.1 Monitoring Objectives, Methods, and Timing

The objective of perimeter surface sediment monitoring adjacent to the RAB is to verify that COC concentrations in adjacent surface sediment (0 to 10 cm) have not significantly increased as a result of the removal action. The perimeter surface sediment monitoring is designed to compare pre-remediation and post-remediation COC concentrations in areas adjacent to the RAB that may have been impacted by the remedial action.

To better assess the potential contributions from removal action construction releases versus off-site sources, samples will be collected in an area directly adjacent to the RAB as well as an upstream area outside the influence of the construction, as shown on Figure 3 of the CQAP (Appendix D). A total of six discrete samples from each area will be chemically analyzed for PCBs, metals, and TOC.

Pre-construction grab samples will be collected at the locations shown in Figure 3 of the CQAP (Appendix D) prior to the start of any removal action activities. Post-construction grab samples will be collected from the locations shown in Figure 3 of the CQAP (Appendix D) as soon as possible after backfill to the final grade is complete.

Additional surface sediment monitoring of sediments adjacent to the RAB may be performed during active remediation, contingent upon removal activity by other LDW parties, concurrent with construction.

8.2 Construction Impacts to Structures or Outfalls

There are no adverse construction impacts anticipated to any outfalls located within or near the RAB.

Within the vicinity of the RAB, there are currently nine outfalls. All six of the outfalls located downstream of the sheetpile wall are inactive as well as outfalls 001 and 002 that historically discharge through the concrete panel and sheetpile walls, respectively. Outfall 003 discharges through the sheetpile wall and is still being used for ongoing Facility stormwater discharges. However, as discussed in Section 6.5, outfall 003 will be abandoned following the installation of a new outfall that will occur concurrently with the removal action construction activities. The newly constructed outfall will extend through the shoreline bank and discharge at approximately -9.5 foot MLLW elevation. The outfall discharge will be equipped with a diffuser arrangement that will be protected from scour and debris. The outfall construction will be sequenced and coordinated with the dredging and shoreline bank reconfiguration.

8.3 Water Quality Impacts

Short-term impacts to water quality may occur during subtidal or intertidal sediment-disturbing construction activities. These potential impacts would be primarily associated with increased turbidity caused by the resuspension or erosion of sediments or backfill material into the water column in active construction areas. Potential turbidity-generating construction activities for this project include dredging and backfilling in the subtidal portions of the RAB, and excavating and slope containment placement in the intertidal portions of the RAB.

A WQMP (Appendix E) will be implemented to confirm that water quality standards are maintained during construction in accordance with EPA's 401 Water Quality Memorandum. Construction BMPs combined with a tiered program of instrumented and chemical water quality monitoring will be performed to monitor and control short-term water quality impacts from project construction activities and to address the substantive requirements of the Water Quality Memorandum.

A detailed description of recommended construction BMPs; water quality monitoring parameters, methods, locations, and schedules; a decision framework for contingency response; reporting requirements; and staff roles and responsibilities are provided in the WQMP (Appendix E). Key aspects of the WQMP are briefly summarized as follows.

8.3.1 Water Quality Criteria

Based on beneficial use classification of the LDW as "excellent quality," the following Class A (excellent quality) marine water quality standards for field parameters will apply to this removal action except within the authorized mixing zone:

- Turbidity. Turbidity must not exceed 5 nephelometric turbidity units (NTU) over background when background turbidity is less than 50 NTU, or have more than a 10 percent increase over background when the background turbidity is greater than 50 NTU.
- Dissolved oxygen (DO). DO shall not drop below 6.0 milligrams per liter (mg/L) at the compliance boundary. When natural conditions such as upwelling occur, causing the DO to be depressed near or below 6.0 mg/L, natural DO levels may be degraded by up to 0.2 mg/L by human-caused activities.
- Temperature. Temperature at the point of compliance shall not exceed 16°C (60.8°F). When the water temperature is naturally warmer than the criterion (or within 0.3°C [0.54°F] of the criterion), then human actions may not cause the 7-day average of daily maximum temperatures to increase more than 0.3°C (0.54°F). When the natural condition of the water is cooler than the criterion, temperature increases must not, at

any time, exceed 12/(*T*-2) as measured at the edge of a mixing zone boundary (where *T* represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge). Additionally, when the natural condition of the water is cooler than the criterion, temperature increases resulting from the combined effect of all non-point source activities in the water body must not, at any time, exceed 2.8°C (5.04°F).

- Hydrogen ion concentration (pH). At the point of compliance, pH shall be within the range of 7.0 to 8.5 with a human-caused variation within this range of less than 0.5 unit.

Compliance with field parameters will be evaluated at the compliance boundary (edge of the mixing zone), which is located 150 feet downcurrent (i.e., downstream during ebb tide and weak flood tides or upstream during strong flood tides) from the construction activity.

In addition, chemical monitoring of the site COCs will be performed during removal action construction activities. Compliance criteria for the COCs will be both the acute and chronic water quality criteria based on the National Recommended Water Quality Criteria for metals and the Washington State Acute Marine Criterion for PCBs (WAC 173-201A-240). Compliance with these criteria will be evaluated at the edge of the 150- and 300-foot compliance boundaries, which are located 150 and 300 feet from the construction work area, respectively.

Finally, the following visual parameters will be monitored during construction:

- Oil Sheen. No oil sheen or product must be visible anywhere in the project area
- Distressed or dying fish. No distressed or dying fish must be visible anywhere in the project area

8.3.2 Monitoring Locations

During each monitoring event, field parameters (i.e., turbidity, DO, temperature, and pH) will be measured at the background station and the upriver or downriver early warning station and 150-foot compliance boundary stations (depending on tide direction), as shown

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on Figure 3 in the WQMP (Appendix E). Chemical monitoring, when required, will be performed at the background, 150- and 300-foot compliance stations (Figure 3). Chemistry samples will be collected from both the background and compliance stations (upriver and downriver) regardless of tidal direction. Samples collected at the background and downcurrent 150-foot and 300-foot compliance stations (depending on tide direction) from the depth with the highest concurrent turbidity will be submitted for analysis. Samples collected at the upcurrent 150-foot and 300-foot compliance stations and all other depths will be archived for future potential analysis, pending results of the samples taken at the downcurrent depth with the highest turbidity (see Section 8.3.4).

The location of the background station will remain the same for all monitoring events. A description of all monitoring stations is provided below and shown on Figure 3 of the WQMP.

- **150-foot Compliance Stations (150C)**. The 150-foot compliance station is located at the edge of the inner mixing zone 150 feet up or downriver (depending on tide direction) from the construction work area. The 150-foot compliance station (Station 150C) is at approximately the same water depth as the construction activity. Compliance with field parameter water quality criteria will be evaluated at the downcurrent 150C station. When required by the monitoring schedule, compliance with COC acute criteria will be evaluated at upcurrent and downcurrent 150C stations.
- **300-foot Compliance Station (300C).** The 300-foot compliance stations are located at the edge of the outer mixing zone 300 feet upriver and downriver from the construction work area. The 300-foot compliance stations (station 300C) are at approximately the same water depth as the construction activity. Compliance with chemical parameter chronic criteria will be evaluated at these stations.
- **Early Warning Station (EW)**. The early warning station (Station EW) is located 75 feet up or downriver (depending on tide direction) from the construction work area, at approximately the same water depth as the construction activity. The objective of the early warning station is to become more quickly aware of potential water quality impacts at the construction work area, and to be able to adjust dredging operations or BMPs before an exceedance occurs at the compliance station.

- **Background Station (BG)**. The background station (Station BG) is located 600 feet upriver from the RAB and beyond the influence of removal action construction activities. Coordinates of the background station are provided on Figure 3 of the WQMP. The background station will be monitored during every event because the turbidity criterion is based on an acceptably small increase in the vicinity of the RAB relative to ambient LDW background levels.

8.3.3 Monitoring Schedules

Water quality monitoring schedules are divided into three tiers for all in-water work, as summarized in Table 2 of the WQMP (Appendix E). Tier I indicates monitoring that will be performed during the first 4 days of in-water removal work. Tier II reflects monitoring that will occur during all in-water removal work after the first 4 days of monitoring have been performed. Finally, Tier III reflects monitoring that will occur during in-water backfill placement. Additionally, chemical monitoring at the Tier I frequency will occur during removal activities performed within three small areas in the RAB showing relatively elevated total PCB concentrations (Figure 4 of the WQMP). The following subsections and Table 2 of the WQMP provide a detailed summary of the monitoring schedules for the specific removal action activities.

8.3.3.1 Tier I Schedule

Tier I monitoring will be conducted concurrent with removal in areas showing the highest relative total PCB concentrations. This level of monitoring will occur for the first 4 days of in-water removal activity (i.e., dredging, in-water debris removal, pile removal or submerged shoreline bank excavation) and includes the measurement of field parameters (i.e., turbidity, DO, temperature, and pH) twice daily at the background, early warning and 150-foot compliance stations. In addition, water samples will be collected for chemical analysis once daily at the background, 150-foot compliance, and 300-foot compliance stations twice during the first 4 days of monitoring.

The first daily monitoring round should be conducted at least 1 hour after the startup of daily work activities. The second daily monitoring round should be separated by a minimum of four hours from the first monitoring round. If practicable, monitoring events should target one flood tide and one ebb tide condition. No monitoring will be performed within two hours before dark and during dark hours due to safety concerns.

As described in Section 8.3.2, during ebb and slack tides, the early warning and 150-foot compliance stations for field parameters will be oriented downriver. During flood tides, the early warning and 150-foot compliance stations for field parameters will be oriented upriver to account for the reversing tidal current, as shown on Figure 3 of the WQMP. When chemical monitoring is required, samples will be collected from both the upriver and downriver 150- and 300-foot compliance stations. Samples collected at the background and downcurrent compliance stations (depending on tide direction) from the depth with the highest concurrent turbidity will be submitted for analysis. Samples collected at the upcurrent compliance stations and all other depths will be archived for future potential analysis, pending results of the sample taken at the downcurrent depth with the highest turbidity (see Section 8.3.4).

8.3.3.2 Tier II Schedule

After 4 consecutive days of Tier I monitoring, monitoring will be reduced to the Tier II schedule, which includes measurement of the field parameters (i.e., turbidity, DO, temperature, and pH) twice daily, three days per week. In addition, water samples will be collected for chemical analysis once daily, twice per week. Field parameter and chemical monitoring will be scheduled each week to coincide with removal of the highest relative total PCB concentrations.

As described in Section 8.3.2, during ebb and slack tides, the early warning and 150-foot compliance stations for field parameters will be oriented downriver. During flood tides, the early warning and 150-foot compliance stations for field parameters will be oriented upriver to account for the reversing tidal current, as shown on Figure 3 of the WQMP. When chemical monitoring is required, samples will be collected from both the upriver and downriver150- and 300-foot compliance stations. Samples collected at the background and downcurrent compliance stations (depending on tide direction) from the depth with the highest concurrent turbidity will be submitted for analysis. Samples collected at the upcurrent compliance stations and all other depths will be archived for future potential

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analysis, pending results of the sample taken at the downcurrent depth with the highest turbidity (see Section 8.3.4).

8.3.3.3 Tier III Schedule

Tier III monitoring will be performed during in-water backfill placement and includes the one-time measurement of field parameters (i.e., turbidity, DO, temperature, and pH) two times in a single day at the background, early warning and 150-foot compliance stations. No chemical monitoring will be performed during backfill placement. No monitoring will be performed within two hours before dark and during dark hours due to safety concerns.

8.3.3.4 Elevated Total PCB Concentration Areas Schedule

During in-water removal activity conducted within the relatively elevated total PCB concentration areas shown on Figure 4 of the WQMP (Appendix E), chemical monitoring at the Tier I frequency will occur (i.e., once daily, twice per week). Chemical samples will be collected from the background and upstream and downstream 150C and 300C stations (Figure 3 of the WQMP). Downcurrent (depending on tide direction) and background samples collected from the depth with the highest turbidity identified with concurrent turbidity measurements will be submitted for analysis. Samples collected at all other depths and upcurrent compliance stations will be archived for future potential analysis, pending results of the sample taken at the downcurrent depth with the highest turbidity (see Section 8.3.4). Field parameters will also be collected at the Tier I schedule.

8.3.4 Responding to Exceedances of Water Quality Criteria

A detailed summary of the necessary response actions if water quality exceedances are identified is provided in the WQMP (Appendix E) and summarized in the subsections below.

8.3.4.1 Exceedance of Conventional Parameters

If conventional parameters (turbidity, DO, temperature, or pH) are exceeded at the 150-foot compliance boundary during removal action construction activities, the following contingency actions will be implemented:

1. Immediately notify Contractor and the Construction Quality Assurance Officer (CQAO).Immediately re-take field measurements at the Compliance Stations (and if necessary, the Background Station) to confirm, or not confirm, the exceedance.
2. If exceedance is confirmed, immediately notify the Contractor, CQAO, and EPA.
3. Evaluate the concurrent measurements at the Background Station and supporting visual evidence to determine whether the exceedance is caused by removal action construction activities versus other ambient conditions in the LDW (e.g., wind waves, boat wakes, barge/ship traffic, or storm inflow).
4. If the exceedance is confirmed and attributed to removal action construction activities:
    a. Immediately notify the Contractor and the CQAO.
    b. The Contractor will be directed to immediately modify operations or implement additional BMPs to mitigate the exceedance (see Section 4 for list of construction BMPs to protect water quality).
    c. Immediately collect additional chemical water samples at the upstream and downstream 150- and 300-foot compliance stations and background station.
        i. Immediately analyze the background and downcurrent compliance stations (depending on tide direction) from the depth with the highest concurrent turbidity. Archive all other samples for future potential analysis, pending results of the sample taken at the downcurrent depth with the highest turbidity (see Section 8.3.2.4).
5. Re-take field measurements at all stations 2 hours later, after additional BMPs or operational modifications are implemented.
6. Within 24 hours, notify EPA of the exceedance, actions taken to mitigate the exceedance, and the results of the follow-up measurements. If the water quality exceedance continues to persist, even with additional BMPs or operational modifications, a path forward will be discussed with EPA. The path forward could include some or all of the following:
    a. Implement more aggressive BMPs or operational modifications.
    b. Implement more intensive monitoring to better track the growth or dissipation of the plume.
    c. If options (a) or (b) are not successful at controlling the water quality exceedance, it may be necessary to stop work to further assess the source of

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the exceedance, identify effective mitigation measures, and allow the water column to recover.

8.3.4.2 Exceedance of Chemical Criteria

If acute criteria are exceeded at the downcurrent 150-foot compliance boundary at the depth with the highest turbidity, or chronic criteria are exceeded at the downcurrent 300-foot compliance boundary at the depth with the highest turbidity, the following actions will be implemented:

1. Immediately notify the Contractor, CQAO, and EPA.
2. In consultation with EPA, evaluate the concurrent measurements at the Background Station and supporting evidence to determine whether the exceedance is caused by removal action construction activities versus other ambient conditions in the LDW (e.g., visual observations, wind waves, boat wakes, barge/ship traffic, other construction activity within the LDW, or storm inflow).
3. If exceedance is attributed to removal action construction activities:
    a. Assess construction methods and existing BMPs.
    b. Analyze concurrent archived samples collected at the compliance boundary (both upstream and downstream) where exceedance was observed to determine if 1-hour average concentrations exceed the compliance criteria.
    c. If 1-hour average concentrations at the 300-foot compliance boundary exceed the chronic criteria, analyze remaining archived samples collected at the 300-foot compliance station on the day of the exceedance to determine if 24-hour concentrations exceed the compliance criteria.
4. If average concentrations exceed the compliance criteria, discuss path forward with EPA. The path forward could include some or all of the following:
    a. Implement more aggressive BMPs or operational modifications.
    b. Implement more intensive monitoring to better track the growth or dissipation of the plume.
    c. If options (a) or (b) are not successful at controlling the water quality exceedance, it may be necessary to temporarily stop work to further assess

the source of the exceedance and identify effective mitigation measures. Additionally, samples may be collected at 200 and 250 feet from construction activity to support a potential modification to the 150-foot mixing zone.

8.3.5 Reporting

Daily, weekly, and final reporting of water quality monitoring results is required for this project as described in the WQMP (Appendix E).

- **Daily Reporting.** Daily field documentation will be scanned and e-mailed to the CQAO at the end of each field day. Unless an exceedance of a water quality parameter occurs (which would trigger contingency response actions), daily field results will not be transmitted to EPA unless specifically requested.
- **Weekly Reporting**. The results from each week's water quality monitoring activities will be compiled into a summary table with a comparison to water quality compliance criteria and provided to EPA as part of the Weekly Progress Report.
- **Final Water Quality Monitoring Results**. After all construction has been completed, the water quality monitoring data for the entire construction project will be provided to EPA in the *Draft Removal Action Completion Report*. This data summary will include a discussion of any water quality exceedances (if any), probable cause of the exceedance(s), results of follow-up measurements, agency communications and decisions, actions taken to mitigate the exceedance(s), and lessons learned for future projects.

9 SUBSTANTIVE REQUIREMENTS OF PERMITS

9.1 Substantive Requirements of Permits/Applicable or Relevant or Appropriate Requirements

All removal actions conducted under CERCLA authority must comply with other state and federal Applicable or Relevant and Appropriate Requirements (ARARs) to the extent practicable given the urgency of the situation and the scope of the removal action (40 CFR 300.415[i]). Local regulations may be included as "to be considered" (TBC) standards, but are not designated as ARARs under CERCLA. ARARs and TBCs are discussed as they pertain to the removal action presented in this document.

ARARs consist of promulgated federal and stricter state environmental or facility siting laws and regulations which are either applicable or relevant and appropriate requirements. EPA, working with the State, consistent with the National Contingency Plan (NCP), is required to identify ARARs that will be met during the implementation of the removal action. TBCs include other than formally promulgated federal and stricter state standards, local government requirements in ordinances and regulations, and other pertinent published criteria, that are TBC by EPA in the implementation of the removal action. TBCs are discretionary rather than mandatory, but compliance is recommended.

For CERCLA actions such as the removal action described in this report, regulatory permits are not required for onsite actions. However, these actions should be conducted in a manner such that the intent or substantive provisions of the permits or regulatory requirements would be met. Actions that occur off-site (e.g., material transportation, dredge material disposal, wastewater discharge to a publicly owned treatment works) are expected to obtain all applicable permits and regulatory approvals.

ARARs identified by EPA in Table 9 were considered in defining the scope and the RAOs for this removal action and in the selection of the recommended removal action alternative in the EE/CA (See Final EE/CA Table 4-1; Anchor QEA 2011a). During the EE/CA process, it was demonstrated that the preferred alternative was in substantive compliance with the CWA Section 404(b)(1) in the CWA Section 404(b)(1) Evaluation (Anchor QEA 2011c). The CWA Section 404(b)(1) concluded that there was no need for compensatory mitigation due to the negligible impacts to waters of the United States and the increase in 500 square feet of intertidal habitat resulting from the implementation of the bank slope reconfiguration and containment.

Anchor QEA and EPA responded to comments from the Services on the BA in February 2012. Formal ESA consultation was completed with the issuance of the Services BiOps on August 22, 2012, and September 27, 2012, respectively. The terms and conditions provided in the BiOps will be evaluated against the Owner final design documents to confirm consistency and applicability. If any issues are identified, Jorgenson Forge will coordinate with EPA to address any inconsistencies.

Table 9 provides a summary of the demonstration of compliance with the ARARs identified for the removal action. During the removal action, the substantive requirements of the EPA-approved ARARs in Table 9 will be met to the extent practicable, as required by the NCP.

10 CONSTRUCTION SEQUENCING AND SCHEDULE

This section describes the planned schedule and construction sequencing for the removal action activities planned in the RAB.

Construction activities are scheduled to commence in August 2013 per the EPA-approved work window. Construction activities are anticipated to last for up to 8 to 12 weeks and are anticipated to be performed 24 hours per day, 5 to 7 days per week consistent with the Boeing DSOA cleanup activities completed in early 2013. Construction activities will commence either concurrently or prior to the CMP and soil removal action to be performed by Jorgensen Forge and Boeing in the uplands directly adjacent to the northwest corner of the Jorgensen Forge property (see Section 2.2.2.1). The CMP and soil removal is currently scheduled to commence in July 2013 and occur for approximately 8 weeks. The rigid containment system (Figure 4) to be installed as part of the CMP and soil removal action shall be fully installed and able to support directly adjacent riverward shoreline bank reconfiguration before the bank reconfiguration construction activities commence.

The Contractor will be required to maintain an up-to-date detailed schedule of activities through construction per the project specifications provided in Appendix H.

The means and methods for construction will ultimately be the Contractor's decision and presented in its RAWP. Anchor QEA foresees the following set of activities occurring during completion of the removal action:

- Mobilization and setup of temporary facilities
- Preconstruction survey
- Top of bank excavation of the soils within the "Ecology Soil Investigation Areas" shown in Figure 8 in the vicinity of soil borings SB-3 and SB-4 (see Section 2.4) followed by placement of clean backfill
- Removal of debris from the shoreline bank area
- Shoreline excavation
- Placement of shoreline bank portion of new outfall structure
- Dredging from the navigation channel to the western boundary of the RAB (general coincident with the navigation channel) starting in upriver area and proceeding

downriver

- Dredging and shoreline acceptance survey by DMU
- Backfilling from the western boundary of the RAB (general coincident with the navigation channel) to the toe of shoreline bank
- Shoreline armor layer placement (filter layer followed by armor layer followed by habitat material) and acceptance surveys by DMU for backfill and shoreline containment materials.
- Final survey and inspections
- Corrective measures, if necessary
- Demobilization and cleanup

For the purposes of this report, the description for construction sequencing is separated into two phases (work performed "in the wet"; work performed "in the dry") as separate equipment and construction methods are envisioned for each. It is highly probable that multiple activities may be occurring at the same time.

10.1 Construction Work Performed in the Wet

Construction activities anticipated to be performed from the water include dredging of chemically impacted sediments from the western boundary of the RAB to the toe of the eastern shoreline and placement of the backfill material over the dredge areas.

Dredging will generally be sequenced from upstream to downstream in order to capture material that migrates downstream during dredging. Dredging will also be completed from top of slope to bottom to minimize the potential for slope instability. Dredging will be performed using mechanical dredging equipment and the removed dredged material will be placed into material barges and transported to the off-site transloading facility for disposal at the appropriate off-site location.

The dredging area will be monitored and defined by station and offset to facilitate continuous tracking of the dredging progress, to allow rapid placement of the backfill material, and to allow final acceptance of a dredging area prior to the entire RAB being completed. The dredge design is based on the DoC found in the investigation phase of the project and on constructability issues (see Section 4).

After dredging has been deemed complete within a DMU by the Contractor, a post-dredge bathymetric survey will be performed to verify that the required dredging depths and extents have been achieved. Once the dredging depth and extents have been verified, a 3 to 6 inch layer of cover material (termed interim backfill) will be placed over the recently dredged area. Backfilling to the final target grade will not be performed until all dredging is complete to prevent possible recontamination of the backfill with residuals from the dredging operations. The backfill material will likely be placed using an excavator or conventional derrick with suitable bucket or skip box that spreads the material uniformly over the bottom of the waterway; the material is typically released just above the water surface as the boom is swung and the material disperses as it falls through the water column. Backfill placement may occur in several lifts in a working area to achieve the design thickness.

Once the full thickness of the backfill material has been placed, a second bathymetric survey (post-backfill) will then be performed over the completed area to verify the appropriate thickness has been placed. The backfill material thickness will be determined by comparing the post-dredge surface to the post-backfill surface.

10.2 Construction Work Performed "In the Dry"

Construction activities anticipated to be performed from land include the shoreline bank piling and debris removal, shoreline bank excavation, placement of the shoreline bank armoring layer, and installation of a portion of the new outfall structure.

Existing derelict creosote-treated piles, overhanging asphalt structures, and debris including concrete debris and riprap, steel rails, chain link fencing, milled wood, and slag will be removed from the bank prior to shoreline excavation. Shoreline bank excavation work will occur from upslope to downslope and will be completed prior to dredging of the adjacent in-water area in order to capture material that moves downslope during the excavation process. It is anticipated that land based excavator equipment will be utilized to complete the shoreline bank excavation and dump trucks will be used to transport the removed material to a transloading facility or directly to the off-site, Subtitle D landfill.

Once the excavation of the shoreline bank within a DMU has been deemed complete by the Contractor, a survey of the shoreline bank will be performed to verify the design extents and slopes have been achieved. Following verification, the various shoreline armoring materials will be placed. Shoreline armoring placement will occur starting at the bottom of the slope and progress upslope and will likely build off of the in-water backfill placement as necessary to maintain a stable slope. This work may be completed using either barge mounted floating equipment or land-based earthmoving equipment (excavators, front-end loaders, and dump trucks). After each layer of armor material is placed a subsequent survey will be performed to ensure the design thickness and grade has been achieved.

Similar to the dredging and backfill activities, this work will begin upstream with the Contractor progressing work downstream.

10.3 Outfall Construction

As discussed in Section 6.5, as part of NPDES permit activities, the existing upland stormwater conveyance system will be modified and the three existing outfalls will be replaced with a single 24-inch diameter outfall located to the north of existing outfall 003 (Figure 9). The new outfall will be extended farther and deeper into the LDW than the current outfalls, which discharge directly from the face of the concrete panel wall (outfall 001) and abutting sheetpile wall (outfall 002 and 003).

Construction of the new stormwater outfall will be completed in multiple phases to allow for installation of a new stormwater treatment system prior to the start of the removal action activities. Following construction of the stormwater treatment system, treated stormwater will be temporarily discharged to the LDW though the existing outfall 003 pending initiation and completion of the removal action activities, whereby the treated stormwater will then be rerouted to discharge from the new outfall and outfall 003 will be abandoned.

Outfall construction up to the property line location near the top of the shoreline bank excavation limits has been completed as part of the work being conducted by Jorgensen Forge as part of their NPDES permit compliance activities. Outfall construction west of the property line location will be completed as part of the removal action activities. The two phases of outfall construction will be well coordinated to ensure successful integration. Outfall construction will follow the general sequence outlined in the following sections.

10.3.1 Phase 1 – Upland Stormwater Conveyance and Treatment Modifications

Stormwater system modifications completed as part of Jorgensen Forge's NPDES permit compliance activities included:

- Intercept outfall 001and 002 conveyance piping and re-route to the existing 003 conveyance piping and outfall
- Abandon outfall 001 and 002 in place
- Install a new pump station to capture the combined flows in the 003 conveyance piping
- Install a high flow bypass weir to convey flows in exceedance of the design storm around the pump station
- Construct an above ground treatment system with discharge temporarily conveyed back to the existing 003 outfall
- Install a new manhole structure (SDMH 1) and initial segment of the new 24-inch outfall piping up to the shoreline bank excavation limits to be completed as part of the removal action

A temporary connection between the new outfall upgradient manhole (SDMH 1) and the existing 003 outfall manhole structure (SDMH 003-2) has been installed as part of phase 1 to allow stormwater flow to continue discharging to the existing 003 outfall. The first segment of the new 24-inch HDPE outfall pipe has been installed beginning at the new SDMH 1 manhole structure and extending up to the property line near the top of bank excavation limits. A flange connection has been installed at this location and temporarily blind flanged so that piping can be continued in phase 2 by connecting the final pipe segment to the flange.

10.3.2 Phase 2 – Bank and in-water Outfall Construction

Excavation and dredging to achieve design inverts for placement of the Phase 2 outfall piping segment will need to be coordinated with the overall bank and sediment removal action activities. Excavation and installation of the outfall piping should be conducted during low tide periods. Following excavation of the outfall pipe trench, gravel ballast bedding material will be placed in accordance with the plans and specifications to achieve design invert elevations.

The means and methods for installation of the piping for Phase 2 will need to be determined by the Contractor. It is anticipated that the entire Phase 2 pipe segment will be fused together on land and dragged and floated to the proper position over the trench excavation. The pipe segment will then be sunk into place using concrete ballasts and backfilled with gravel ballast bedding material in accordance with the plans and specifications. The excavation will then be backfilled to finish grade in accordance with the plans and specifications.

Following installation and connection of the final outfall segment to the phase 1 segment, stormwater discharge will be diverted to the new outfall by permanently capping the existing 003 outfall pipe within SDMH 1. The discharge end of the existing 003 outfall pipe will also be permanently capped.

10.4 Coordination with Property Line Pipes Removal Action and Boeing DSOA Corrective Action

As discussed in Section 2.2.2.1, Jorgensen Forge and Boeing are currently coordinating with EPA to perform the removal of the CMP that exists in the furthest downgradient portions of the property line pipes as well as soils in the direct vicinity of these pipes that contain elevated PCBs (Figure 3). Jorgensen Forge and Boeing are currently working with EPA to execute a Second Modification to the AOC and development of the removal action design documents in order for this work to be conducted either concurrently or following the removal action activities within the RAB. At a minimum, a sheetpile wall will be installed on the on the shoreline bank at the appropriate schedule to facilitate the sediment removal action activities within the RAB immediately adjacent to the sheetpile wall.

Per the MOU between Boeing and the Owner (EMJ et al. 2007), the southern portion of the Boeing DSOA cleanup is anticipated to occur immediately following the removal action within the RAB and the backfill operations for both projects will be sequenced to minimize the potential for recontamination of the RAB. The Owner and Boeing continue to coordinate during the design development process to establish a seamless transition in the shoreline bank and in-water "transition zone" between the two cleanup projects and ensure all sediments with RvAL exceedances are removed.

11 LONG-TERM OPERATIONS, MONITORING, AND MAINTENANCE

Long-term monitoring will be performed to confirm that removal action performance standards are being met in the years following construction, and to demonstrate that Facility source controls are effectively protecting the quality of the adjacent LDW sediments and preventing their recontamination. Detailed sampling methods, sampling station coordinates, quality control protocols, and contingency response plans are provided in the Operations, Monitoring, and Maintenance Plan (OMMP; Appendix F).

A summary of long-term monitoring methods and objectives is provided in this section.

11.1 Performance Standards

The following are the proposed standards that will be used to evaluate the long-term performance of the removal action.

- **Sediment Recontamination**. Clean imported sediments will be placed throughout the entire in-water and shoreline bank areas in the RAB following completion of the removal action. Over time, this clean sediment surface is expected to increase in concentration due to migration of chemicals from ongoing off-site sources in the LDW. The changes in surface sediment concentration within the RAB will be evaluated over time.
- **Shoreline Bank Containment Integrity**. Shoreline bank area of the RAB will be contained with a 1.5-foot filter material layer, overlain by a 2.5-foot riprap material layer, further overlain by a 0.5-foot layer of habitat substrate. The integrity of this containment will be maintained over the long term. Specifically, the bank will be inspected for significant signs of sloughing or erosion. Note that the intent of the habitat substrate is to allow it to naturally accrete or erode; it will not be specifically maintained.

11.2 Monitoring Activities

The following long-term monitoring activities will be performed to confirm the performance standards of the removal action are being met.

11.2.1 Monitoring of Sediment Quality

Post-construction surface sediment monitoring will be performed in the RAB to monitor changes in surface sediment concentrations over time. To evaluate changes in surface sediment concentrations within the RAB, surface sediment samples will be collected within the dredging areas (Figure 3 of the OMMP in Appendix F). Surface sediment samples will be collected and submitted for chemical analysis for the site COCs defined in the OMMP (Appendix F). In addition, surface samples will be collected from two other areas, including one immediately adjacent area outside the RAB, and one area upstream from the RAB (Figure 3 of the OMMP in Appendix F). Samples collected from areas outside the RAB will be archived to support potential future analysis of off-site sources.

An initial Year 0 sediment sampling event will be conducted as part of the CQAP activities to verify the final "as built" quality of the sediment surface at the close of construction (in addition to the "Z-Layer" sampling described in the CQAP). This will serve as the baseline condition to compare with subsequent sediment sampling events conducted under the OMMP.

Sediment sampling under the OMMP will be performed at all locations in Years 1, 3, 5, 7, and 10 following the completion of the removal action. The monitoring schedule will be re-evaluated in consultation with EPA after the first two events are completed and analyzed. The monitoring frequency may be decreased if sediment concentrations are consistently below the RvAL.

11.2.2 Visual Monitoring of Shoreline Area

Visual monitoring will be performed in the Reconfigured Bank Monitoring Area, shown on Figure 3 in the OMMP (Appendix F) to verify that slope containment remains stable and there are no signs of significant riprap movement, sloughing, or erosion. In addition, the condition and coverage of the 0.5-foot habitat cover layer will be visually assessed. Note that the intent of the habitat cover layer is to allow it to naturally migrate and come to equilibrium based on the encountered erosional force and that it will not be maintained.

A visual survey of the shoreline bank area will be completed that will look for evidence of sloughing and erosion to ensure that the function and integrity of the shoreline containment is being maintained. In addition, a visual survey of the habitat layer will be completed to estimate the coverage of the habitat material over the riprap. Observers will walk the entire shoreline area looking for areas of erosion or accretion. The estimated percent coverage of riprap by the habitat layer, areas of exposed riprap, and the estimated thickness of the habitat layer will be recorded.

If sloughing, erosion, or movement of the riprap layer is observed over a significant portion of the shoreline, contingency response actions will be evaluated. Because the habitat cover layer is expected to naturally migrate and come to equilibrium in response to river dynamics, the loss of this material from the shoreline area will not trigger a response action.

Visual monitoring of the shoreline area will be performed in Years 1, 3, 5, 7, and 10 following the completion of the removal action. Contingent visual monitoring of the shoreline area will be performed in response to a storm event or flood event of 25-year return period or greater, if one happens to occur in the LDW during the OMMP monitoring period.

11.3 Contingency Response Actions

The OMMP (Appendix F) describes potential response actions that will be undertaken if monitoring results indicate long-term performance standards are not being met. Contingency response actions are specific to the particular monitoring activity and objective (i.e., monitoring to prevent slope movement in the backfill area, recontamination within the RAB, and erosion of the shoreline containment). Depending on the nature and severity of the performance issue, the contingency response actions will be decided in consultation with EPA and may include one or more of the following:

- Increased monitoring frequency, potentially including a follow-up round of confirmation sediment testing
- Upland source tracing and environmental monitoring to better identify sources of recontamination
- Evaluation of additional cost-effective source control measures or BMPs

- Implementation of slope stabilization measures
- Application of thin sand cover layer to subtidal areas
- Application of additional armor thickness, or larger armor material, to shoreline containment area

11.4 Reporting

OMMP (Appendix F) monitoring reports will be prepared following Year 1, 3, 5, 7, and 10 monitoring events, as well as any emergency monitoring events that may need to be conducted in response to a severe storm or flood. Specific reporting requirements are presented in the OMMP.

12 INSTITUTIONAL CONTROLS

The Action Memo for the removal action includes institutional controls as part of the proposed action (EPA 2011a). The Final EE/CA indicated that the complete removal of impacted sediments would be preferable, in small part due to the fact that complete removal would lead to reduced area requiring long-term maintenance or institutional controls (Anchor QEA 2011a). Institutional controls generally consist of activities, documents, information devices, physical restrictions, or legal restrictions that ensure the protectiveness of the remedy and minimize, limit, or prevent human exposures to site COCs. They do not include active remediation actions. The Action Memo indicates that the removal action institutional controls should consist only of the LDW-wide fish consumption advisory (EPA 2011a). EPA is currently evaluating whether additional institutional controls should be implemented to further protect the community and stakeholders and is coordinating directly with the Owner on this issue.

This section presents the plan for implementing the specific institutional control identified by EPA for the Facility. Documentation of implementation of the institutional control will be submitted after removal action construction.

12.1 Purpose and Objectives of Institutional Controls for RAB

The proposed removal action does not include placement of engineered caps, and dredging is intended to remove the full extent of PCB contamination from the sediment and place backfill comprised of suitable substrate to the existing grade. Therefore, the area requiring coverage by institutional controls is minimized. The shoreline bank reconfiguration involves placement of material that should be protected from future disturbance without first notifying appropriate regulatory authorities. EPA indicated that the waterway-wide institutional controls may be applicable and that the scope of those controls under currently being evaluated.

Land use within the RAB primarily consists of commercial and recreational navigation, sport fishing, and Tribal fishing. The backfill areas would not be required to be protected from small-vessel anchorage, fishing, or clamming activities associated with these potential uses. Commercial navigation would occur directly west of the channelward extents of the RAB and future navigational dredging may extend some distance into the channelward SMUs. Industrial land use would continue on adjacent upland parcels.

Therefore, the seafood consumption advisories issued by the Washington State Department of Health (WSDOH) are likely to be maintained and potentially expanded as an institutional control for the entire LDW, including the RAB. Consumption advisories would not be necessary for the removal action alone, because clean material will be used as backfill following dredging, and the seafood consumption advisories apply to many organisms that range over a much larger area.

The necessary institutional controls could be fully implemented within approximately 1 year of construction completion. Engineering controls, BMPs, and other measures to ensure compliance with ARARs would control short-term risks during implementation.

13 CULTURAL RESOURCES ASSESSMENT

For the proposed removal action, EPA must substantively comply with Section 106 and its implementing regulations at 36 CFR 800. CERCLA Section 121(e)(1) provides that no federal, state, or local permits are required for remedial activities conducted entirely on site. However, this does not remove the requirement to meet (or waive) the substantive provisions of permitting regulations that are ARARs. Section 106 is an ARAR for the proposed removal action. Section 106 requires federal agencies to consider the effects of their undertakings on historic properties listed in (or eligible for listing in) the National Register of Historic Places (NRHP). Thirty-six CFR 800 describes a five-step process for implementing Section 106:

1. Consult with the State Historic Preservation Officer (SHPO), interested and affected Indian Tribes, interested parties, and the public;
2. Determine the undertaking's Area of Potential Effects (APE);
3. Determine whether potential historic properties are present in the APE;
4. Evaluate whether the properties are NRHP-eligible, and if so, whether the project will affect them; and
5. Mitigate adverse effects to NRHP-eligible historic properties.

The Cultural Resources Assessment provided in Appendix M is intended to assist EPA in complying with Section 106 and 36 CFR 800 by describing the APE, describing known and potential historic properties in the APE, and recommending NRHP eligibility and project effects.

Appendix D of the Construction Specifications (Appendix H to this BODR) provides an Inadvertent Discovery Plan that describes actions that should be taken in the event of a discovery of archaeological materials or human remains, to ensure that the project remains in compliance with the applicable state laws.

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TABLES

Table 1
2011 Sampling Results

				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-01	JVE-01	JVE-01	JVE-01	JVE-01	JVE-01
				Sample ID	JVE-01SC-0001-110218	JVE-01SC-0102-110218	JVE-01SC-0203-110218	JVE-01SC-0304-110218	JVE-01SC-0405-110218	JVE-01SC-0506-110218
				Sample Date	2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011
				Depth	0 - 1 ft	1 - 2 ft	2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft
				Sample Type	N	N	N	N	N	N
				X	1275754.04	1275754.04	1275754.04	1275754.04	1275754.04	1275754.04
				Y	195763.89	195763.89	195763.89	195763.89	195763.89	195763.89
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					3.21	2.5	0.528	0.347	0.118	0.292
Total solids					47.8	59.4	80.9	80.7	93.4	85.9
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	**37000**	N/A	N/A	**400**	20 U	20 U
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	**400**	**200**	N/A	N/A	N/A

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-01	JVE-01	JVE-01	JVE-01	JVE-02	JVE-02
				Sample ID	JVE-01SC-0607-110218	JVE-01SC-0708-110218	JVE-01SC-0809-110218	JVE-01SC-099.7-110218	JVE-02SC-0001-110221	JVE-02SC-0102-110221
				Sample Date	2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/21/2011	2/21/2011
				Depth	6 - 7 ft	7 - 8 ft	8 - 9 ft	9 - 9.7 ft	0 - 1 ft	1 - 2 ft
				Sample Type	N	N	N	N	N	N
				X	1275754.04	1275754.04	1275754.04	1275754.04	1275803.40	1275803.40
				Y	195763.89	195763.89	195763.89	195763.89	195713.39	195713.39
Conventional Parameters (pct)										
Total organic carbon					**0.467**	**0.315**	**0.048**	**0.068**	**2.57**	**0.153**
Total solids					**80.6**	**83.5**	**87.9**	**81.8**	**76.6**	**80.9**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	19 U	20 UJ	**20 J**	19 U	N/A	**100**
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	N/A	N/A	**320**	N/A

EMJ014152

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-02	JVE-02	JVE-02	JVE-02	JVE-02	JVE-02
Sample ID					JVE-02SC-0203-110221	JVE-02SC-0304-110221	JVE-02SC-0405-110221	JVE-02SC-0506-110221	JVE-02SC-0607-110221	JVE-02SC-0708-110221
Sample Date					2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011
Depth					2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
Sample Type					N	N	N	N	N	N
X					1275803.40	1275803.40	1275803.40	1275803.40	1275803.40	1275803.40
Y					195713.39	195713.39	195713.39	195713.39	195713.39	195713.39
Conventional Parameters (pct)										
Total organic carbon					**0.114**	**0.081**	**0.101**	**0.11**	**0.071**	**0.044**
Total solids					**79.5**	**84.5**	**91.9**	**87**	**85.2**	**87**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	20 U	20 U	19 U	20 U	20 U	20 UJ
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	N/A	N/A	N/A	N/A

Table 1
2011 Sampling Results

				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-02	JVE-02	JVE-03	JVE-03	JVE-03	JVE-03
				Sample ID	JVE-02SC-0809-110221	JVE-02SC-099.6-110221	JVE-03SC-0405-110221	JVE-03SC-0506-110221	JVE-03SC-0607-110221	JVE-03SC-0708-110221
				Sample Date	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011
				Depth	8 - 9 ft	9 - 9.6 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
				Sample Type	N	N	N	N	N	N
				X	1275803.40	1275803.40	1275760.37	1275760.37	1275760.37	1275760.37
				Y	195713.39	195713.39	195683.32	195683.32	195683.32	195683.32
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					**0.096**	**0.072**	**2.21**	**2.47**	**1.86**	**1.49**
Total solids					**82.8**	**84.5**	**53**	**51.1**	**63**	**59.6**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	20 UJ	19 U	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	**60**	**60**	**70**	**6**

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-03	JVE-03	JVE-03	JVE-03	JVE-04	JVE-04
				Sample ID	JVE-03SC-0809-110221	JVE-03SC-0910-110221	JVE-03SC-1011-110221	JVE-03SC-1112.2-110221	JVE-04SC-0001-110221	JVE-04SC-0102-110221
				Sample Date	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011
				Depth	8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12.2 ft	0 - 1 ft	1 - 2 ft
				Sample Type	N	N	N	N	N	N
				X	1275760.37	1275760.37	1275760.37	1275760.37	1275802.99	1275802.99
				Y	195683.32	195683.32	195683.32	195683.32	195674.60	195674.60
Conventional Parameters (pct)										
Total organic carbon					**1.31**	**1.33**	**1.38**	**1.2**	**2.54**	**1.66**
Total solids					**75.2**	**74.8**	**74.1**	**76.4**	**53.8**	**77.8**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**10**	**1.7**	**5**	**10**	**20**	**10**

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-04	JVE-04	JVE-04	JVE-04	JVE-04	JVE-04
Sample ID					JVE-04SC-0203-110221	JVE-04SC-0304-110221	JVE-04SC-0405-110221	JVE-04SC-0506-110221	JVE-04SC-0607-110221	JVE-04SC-0708-110221
Sample Date					2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011	2/21/2011
Depth					2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
Sample Type					N	N	N	N	N	N
X					1275802.99	1275802.99	1275802.99	1275802.99	1275802.99	1275802.99
Y					195674.60	195674.60	195674.60	195674.60	195674.60	195674.60
Conventional Parameters (pct)										
Total organic carbon					**0.167**	**0.357**	**0.114**	**0.142**	**0.085**	**0.138**
Total solids					**81.9**	**81.6**	**86.1**	**81.4**	**84.3**	**85**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	**54**	**71 J**	20 U	16 U	16 U	16 U
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	N/A	N/A	N/A	N/A

EMJ014156

Table 1
2011 Sampling Results

				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-04	JVE-04	JVE-07	JVE-07	JVE-07	JVE-07
				Sample ID	JVE-04SC-089.2-110221	JVE-1004SC-0607-110221	JVE-07SC-0001-110218	JVE-07SC-0102-110218	JVE-07SC-0203-110218	JVE-07SC-0304-110218
				Sample Date	2/21/2011	2/21/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011
				Depth	8 - 9.2 ft	6 - 7 ft	0 - 1 ft	1 - 2 ft	2 - 3 ft	3 - 4 ft
				Sample Type	N	FD	N	N	N	N
				X	1275802.99	1275802.99	1275915.53	1275915.53	1275915.53	1275915.53
				Y	195674.60	195674.60	195362.27	195362.27	195362.27	195362.27
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					**0.104**	**0.11**	**2.43**	**1.68**	**1.72**	**2.55**
Total solids					**86.2**	**86.1**	**55.1**	**56.5**	**58.1**	**55.8**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	19 U	20 U	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	**7 J**	**10 J**	**7**	**7**

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-07	JVE-07	JVE-07	JVE-07	JVE-07	JVE-07
Sample ID					JVE-07SC-0405-110218	JVE-07SC-0506-110218	JVE-07SC-0607-110218	JVE-07SC-0708-110218	JVE-07SC-0809-110218	JVE-07SC-0910-110218
Sample Date					2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011
Depth					4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft	8 - 9 ft	9 - 10 ft
Sample Type					N	N	N	N	N	N
X					1275915.53	1275915.53	1275915.53	1275915.53	1275915.53	1275915.53
Y					195362.27	195362.27	195362.27	195362.27	195362.27	195362.27
Conventional Parameters (pct)										
Total organic carbon					**1.29**	**1.44**	**0.825**	**0.396**	**1.69**	**2.23**
Total solids					**59.5**	**66**	**73.1**	**79.1**	**83.4**	**78.1**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	20 U	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**6.7**	**1.9 J**	**4 J**	N/A	1.1 UJ	0.9 U

Table 1
2011 Sampling Results

					Task	Location ID	Sample ID	Sample Date	Depth	Sample Type	X	Y
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-07	JVE-07SC-1011-110218	2/18/2011	10 - 11 ft	N	1275915.53	195362.27
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-07	JVE-07SC-1112.2-110218	2/18/2011	11 - 12.2 ft	N	1275915.53	195362.27
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-07	JVE-1007SC-0910-110218	2/18/2011	9 - 10 ft	FD	1275915.53	195362.27
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-205	JVE-1205SC-0203-110217	2/17/2011	2 - 3 ft	FD	1275755.33	195646.27
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-205	JVE-205SC-0203-110217	2/17/2011	2 - 3 ft	N	1275755.33	195646.27
					Jorgensen Forge - Design Subsurface Sediment Sampling	JVE-205	JVE-205SC-0304-110217	2/17/2011	3 - 4 ft	N	1275755.33	195646.27

	SMS_SQS	SMS_CSL	LAET	2LAET	JVE-07SC-1011-110218	JVE-07SC-1112.2-110218	JVE-1007SC-0910-110218	JVE-1205SC-0203-110217	JVE-205SC-0203-110217	JVE-205SC-0304-110217
Conventional Parameters (pct)										
Total organic carbon					**1.39**	**4.39**	**3.98**	**1.66**	**1.55**	**1.93**
Total solids					**76.7**	**76**	**77.1**	**52.3**	**52.4**	**53.7**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	20 U	19 U	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			1 U	N/A	N/A	1 U	**20**	**10**

EMJ014159

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-205	JVE-205	JVE-205	JVE-205	JVE-205	JVE-205
				Sample ID	JVE-205SC-0405-110217	JVE-205SC-0506-110217	JVE-205SC-0607-110217	JVE-205SC-0708-110217	JVE-205SC-0809-110217	JVE-205SC-0910-110217
				Sample Date	2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011
				Depth	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft	8 - 9 ft	9 - 10 ft
				Sample Type	N	N	N	N	N	N
				X	1275755.33	1275755.33	1275755.33	1275755.33	1275755.33	1275755.33
				Y	195646.27	195646.27	195646.27	195646.27	195646.27	195646.27
Conventional Parameters (pct)										
Total organic carbon					1.97	2.28	2.58	1.69	2.67	0.724
Total solids					51.9	50.5	53	60.6	61.5	59.2
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			30	10	110	110	60	9

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-205	JVE-205	JVE-206	JVE-206	JVE-206	JVE-206
Sample ID					JVE-205SC-1011-110217	JVE-205SC-1112.1-110217	JVE-1206SC-1011-110316	JVE-206SC-0607-110316	JVE-206SC-0708-110316	JVE-206SC-0809-110316
Sample Date					2/17/2011	2/17/2011	3/16/2011	3/16/2011	3/16/2011	3/16/2011
Depth					10 - 11 ft	11 - 12.1 ft	10 - 11 ft	6 - 7 ft	7 - 8 ft	8 - 9 ft
Sample Type					N	N	FD	N	N	N
X					1275755.33	1275755.33	1275801.559430	1275801.559430	1275801.559430	1275801.559430
Y					195646.27	195646.27	195612.970248	195612.970248	195612.970248	195612.970248
Conventional Parameters (pct)										
Total organic carbon					0.511	0.821	1.69	2.48	2.1	2.19
Total solids					78.3	69	68.2	52.7	56.3	58.9
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			4 U	11	5	10	60	21 J

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-206	JVE-206	JVE-206	JVE-206	JVE-206	JVE-207
				Sample ID	JVE-206SC-0910-110316	JVE-206SC-1011-110316	JVE-206SC-1112-110316	JVE-206SC-1213-110316	JVE-206SC-1313.6-110316	JVE-207SC-0102-110216
				Sample Date	3/16/2011	3/16/2011	3/16/2011	3/16/2011	3/16/2011	2/16/2011
				Depth	9 - 10 ft	10 - 11 ft	11 - 12 ft	12 - 13 ft	13 - 13.6 ft	1 - 2 ft
				Sample Type	N	N	N	N	N	N
				X	1275801.559430	1275801.559430	1275801.559430	1275801.559430	1275801.559430	1275817.24
				Y	195612.970248	195612.970248	195612.970248	195612.970248	195612.970248	195556.36
Conventional Parameters (pct)										
Total organic carbon					1.76	1.54	2.24	1.78	1.67	2.03
Total solids					62.3	68	66.8	69.2	70.1	48
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			20	4	4	6	5	10 J

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-207	JVE-207	JVE-207	JVE-207	JVE-207	JVE-207
Sample ID					JVE-207SC-0203-110216	JVE-207SC-0304-110216	JVE-207SC-0405-110216	JVE-207SC-0506-110216	JVE-207SC-0607-110216	JVE-207SC-0708-110216
Sample Date					2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011
Depth					2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
Sample Type					N	N	N	N	N	N
X					1275817.24	1275817.24	1275817.24	1275817.24	1275817.24	1275817.24
Y					195556.36	195556.36	195556.36	195556.36	195556.36	195556.36
Conventional Parameters (pct)										
Total organic carbon					**1.73**	**2.06**	**2.77**	**2.53**	**2.38**	**1.88**
Total solids					**54.3**	**51.8**	**52.3**	**52.1**	**55**	**60.3**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**3**	**6**	**3**	0.8 U	**20**	**2.4**

Table 1
2011 Sampling Results

				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-207	JVE-207	JVE-207	JVE-207	JVE-207	JVE-208
				Sample ID	JVE-207SC-0809-110216	JVE-207SC-0910-110216	JVE-207SC-1011-110216	JVE-207SC-1112-110216	JVE-207SC-1212.6-110216	JVE-208SC-0506-110316
				Sample Date	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011	3/16/2011
				Depth	8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12 ft	12 - 12.6 ft	5 - 6 ft
				Sample Type	N	N	N	N	N	N
				X	1275817.24	1275817.24	1275817.24	1275817.24	1275817.24	1275835.476860
				Y	195556.36	195556.36	195556.36	195556.36	195556.36	195513.207034
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					**2.23**	**3.46**	**1.06**	**1.47**	**0.095**	**2.27**
Total solids					**62.6**	**62.2**	**70.2**	**71.5**	**80.8**	**50.9**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	**30**	N/A	N/A	20 U	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**1**	N/A	1.8 U	**1.8**	N/A	**10 J**

Table 1
2011 Sampling Results

Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-208	JVE-208	JVE-208	JVE-208	JVE-208	JVE-208
Sample ID					JVE-208SC-0607-110316	JVE-208SC-0708-110316	JVE-208SC-0809-110316	JVE-208SC-0910-110316	JVE-208SC-1011-110316	JVE-208SC-1112-110316
Sample Date					3/16/2011	3/16/2011	3/16/2011	3/16/2011	3/16/2011	3/16/2011
Depth					6 - 7 ft	7 - 8 ft	8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12 ft
Sample Type					N	N	N	N	N	N
X					1275835.476860	1275835.476860	1275835.476860	1275835.476860	1275835.476860	1275835.476860
Y					195513.207034	195513.207034	195513.207034	195513.207034	195513.207034	195513.207034
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					2.41	2.71	2.78	2.79	2.24	2.02
Total solids					52.9	55.1	55.2	55.4	64.3	66
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			50	190	200	160	21	6

Table 1
2011 Sampling Results

				Task	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**
				Location ID	**JVE-208**	**JVE-210**	**JVE-210**	**JVE-210**	**JVE-210**	**JVE-210**
				Sample ID	**JVE-208SC-1212.5-110316**	**JVE-210SC-0001-110216**	**JVE-210SC-0102-110216**	**JVE-210SC-0203-110216**	**JVE-210SC-0304-110216**	**JVE-210SC-0405-110216**
				Sample Date	**3/16/2011**	**2/16/2011**	**2/16/2011**	**2/16/2011**	**2/16/2011**	**2/16/2011**
				Depth	**12 - 12.5 ft**	**0 - 1 ft**	**1 - 2 ft**	**2 - 3 ft**	**3 - 4 ft**	**4 - 5 ft**
				Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
				X	**1275835.476860**	**1275858.39**	**1275858.39**	**1275858.39**	**1275858.39**	**1275858.39**
				Y	**195513.207034**	**195359.42**	**195359.42**	**195359.42**	**195359.42**	**195359.42**
	SMS_SQS	**SMS_CSL**	**LAET**	**2LAET**						
Conventional Parameters (pct)										
Total organic carbon					**0.11**	**2.62**	**2.11**	**1.77**	**1.85**	**2.39**
Total solids					**81.7**	**47.6**	**50**	**56.1**	**52.7**	**56.3**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	120 U	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	**8 J**	**4**	1 U	1 U	**2**

EMJ014166

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-210	JVE-210	JVE-210	JVE-210	JVE-210	JVE-210
Sample ID					JVE-210SC-0506-110216	JVE-210SC-0607-110216	JVE-210SC-0708-110216	JVE-210SC-0809-110216	JVE-210SC-0910-110216	JVE-210SC-1011-110216
Sample Date					2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011
Depth					5 - 6 ft	6 - 7 ft	7 - 8 ft	8 - 9 ft	9 - 10 ft	10 - 11 ft
Sample Type					N	N	N	N	N	N
X					1275858.39	1275858.39	1275858.39	1275858.39	1275858.39	1275858.39
Y					195359.42	195359.42	195359.42	195359.42	195359.42	195359.42
Conventional Parameters (pct)										
Total organic carbon					**2.04**	**2.33**	**2.64**	**1.14**	**0.272**	**1.19**
Total solids					**56.8**	**64.9**	**66.2**	**77.3**	**82.9**	**80.7**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	20 U	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**1**	**1**	**1**	2 U	N/A	2 U

Table 1
2011 Sampling Results

				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-210	JVE-210	JVE-215	JVE-215	JVE-215	JVE-215
				Sample ID	JVE-210SC-1112-110216	JVE-210SC-1212.7-110216	JVE-1215SC-0607-110216	JVE-215SC-0001-110216	JVE-215SC-0102-110216	JVE-215SC-0203-110216
				Sample Date	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011
				Depth	11 - 12 ft	12 - 12.7 ft	6 - 7 ft	0 - 1 ft	1 - 2 ft	2 - 3 ft
				Sample Type	N	N	FD	N	N	N
				X	1275858.39	1275858.39	1275842.73	1275842.73	1275842.73	1275842.73
				Y	195359.42	195359.42	195459.56	195459.56	195459.56	195459.56
	SMS_SQS	SMS_CSL	LAET	2LAET						
Conventional Parameters (pct)										
Total organic carbon					**4.51**	**2.7**	**2.08**	**2.26**	**1.53**	**2.11**
Total solids					**66.3**	**63.5**	**62.5**	**47.5**	**51.5**	**53.8**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	20 U	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	0.7 U	**2**	**9 J**	**10**	**1**

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-215	JVE-215	JVE-215	JVE-215	JVE-215	JVE-215
				Sample ID	JVE-215SC-0304-110216	JVE-215SC-0405-110216	JVE-215SC-0506-110216	JVE-215SC-0607-110216	JVE-215SC-0708-110216	JVE-215SC-0809-110216
				Sample Date	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/16/2011
				Depth	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft	8 - 9 ft
				Sample Type	N	N	N	N	N	N
				X	1275842.73	1275842.73	1275842.73	1275842.73	1275842.73	1275842.73
				Y	195459.56	195459.56	195459.56	195459.56	195459.56	195459.56
Conventional Parameters (pct)										
Total organic carbon					**1.82**	**1.06**	**2.5**	**1.58**	**1.52**	**1.78**
Total solids					**57.7**	**58**	**59.1**	**62.6**	**65.4**	**63**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**6**	2 U	0.8 U	**5.5**	1.3 U	1 U

EMJ014169

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
				Location ID	JVE-215	JVE-215	JVE-215	JVE-215	JVE-216	JVE-216
				Sample ID	JVE-215SC-0910-110216	JVE-215SC-1011-110216	JVE-215SC-1112-110216	JVE-215SC-1212.8-110216	JVE-216SC-0506-110218	JVE-216SC-0607-110218
				Sample Date	2/16/2011	2/16/2011	2/16/2011	2/16/2011	2/18/2011	2/18/2011
				Depth	9 - 10 ft	10 - 11 ft	11 - 12 ft	12 - 12.8 ft	5 - 6 ft	6 - 7 ft
				Sample Type	N	N	N	N	N	N
				X	1275842.73	1275842.73	1275842.73	1275842.73	1275928.90	1275928.90
				Y	195459.56	195459.56	195459.56	195459.56	195180.94	195180.94
Conventional Parameters (pct)										
Total organic carbon					**1.95**	**1.4**	**0.649**	**0.39**	**2.05**	**1.63**
Total solids					**61.2**	**70.1**	**74.7**	**75.6**	**65**	**70.9**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	19 U	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**1**	1 U	2.9 U	N/A	**33**	**2.5**

EMJ014170

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-216	JVE-216	JVE-216	JVE-216	JVE-216	JVE-309
Sample ID					JVE-216SC-0708-110218	JVE-216SC-0809-110218	JVE-216SC-0910-110218	JVE-216SC-1011-110218	JVE-216SC-1112.1-110218	JVE-1309SC-0910-110217
Sample Date					2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/17/2011
Depth					7 - 8 ft	8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12.1 ft	9 - 10 ft
Sample Type					N	N	N	N	N	FD
X					1275928.90	1275928.90	1275928.90	1275928.90	1275928.90	1275852.94
Y					195180.94	195180.94	195180.94	195180.94	195180.94	195575.56
Conventional Parameters (pct)										
Total organic carbon					**0.12**	**0.16**	**0.127**	**0.24**	**0.327**	**0.138**
Total solids					**86.9**	**85.2**	**83.8**	**86.2**	**80.2**	**79.4**
PCB Aroclors (μg/kg)										
Total PCB Aroclors (U = 0)			130	1000	20 U	19 U	19 UJ	19 U	20 U	20 U
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	N/A	N/A	N/A	N/A	N/A

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-309	JVE-309	JVE-309	JVE-309	JVE-309	JVE-309
Sample ID					JVE-309SC-0203-110217	JVE-309SC-0304-110217	JVE-309SC-0405-110217	JVE-309SC-0506-110217	JVE-309SC-0607-110217	JVE-309SC-0708-110217
Sample Date					2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011
Depth					2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
Sample Type					N	N	N	N	N	N
X					1275852.94	1275852.94	1275852.94	1275852.94	1275852.94	1275852.94
Y					195575.56	195575.56	195575.56	195575.56	195575.56	195575.56
Conventional Parameters (pct)										
Total organic carbon					0.551	0.206	0.137	1.03	0.131	0.617
Total solids					77.9	84.6	81.6	81.1	80.2	75.2
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	32 U	20 U	N/A	20 U	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			70	N/A	N/A	2 U	N/A	3.1 U

EMJ014172

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
				Task	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**
				Location ID	**JVE-309**	**JVE-309**	**JVE-309**	**JVE-309**	**JVE-311**	**JVE-311**
				Sample ID	**JVE-309SC-0809-110217**	**JVE-309SC-0910-110217**	**JVE-309SC-1011-110217**	**JVE-309SC-1111.5-110217**	**JVE-311SC-0506-110217**	**JVE-311SC-0607-110217**
				Sample Date	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**
				Depth	**8 - 9 ft**	**9 - 10 ft**	**10 - 11 ft**	**11 - 11.5 ft**	**5 - 6 ft**	**6 - 7 ft**
				Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
				X	**1275852.94**	**1275852.94**	**1275852.94**	**1275852.94**	**1275895.34**	**1275895.34**
				Y	**195575.56**	**195575.56**	**195575.56**	**195575.56**	**195460.86**	**195460.86**
Conventional Parameters (pct)										
Total organic carbon					**0.767**	**0.185**	**0.376**	**2.55**	**0.734**	**0.304**
Total solids					**73.7**	**78.7**	**76.2**	**60.2**	**77.2**	**77.7**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	20 U	20 U	N/A	N/A	19 U
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			3 U	N/A	N/A	0.8 U	**20**	N/A

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-311	JVE-311	JVE-314	JVE-314	JVE-314	JVE-314
Sample ID					JVE-311SC-0708-110217	JVE-311SC-089.4-110217	JVE-1314SC-0506-110218	JVE-314SC-0001-110218	JVE-314SC-0102-110218	JVE-314SC-0203-110218
Sample Date					2/17/2011	2/17/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011
Depth					7 - 8 ft	8 - 9.4 ft	5 - 6 ft	0 - 1 ft	1 - 2 ft	2 - 3 ft
Sample Type					N	N	FD	N	N	N
X					1275895.34	1275895.34	1275966.80	1275966.80	1275966.80	1275966.80
Y					195460.86	195460.86	195235.18	195235.18	195235.18	195235.18
Conventional Parameters (pct)										
Total organic carbon					0.113	0.829	0.581	1.94	1.04	0.815
Total solids					82.9	84.7	85	61.7	66.4	77.2
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	20 U	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			N/A	2 U	3.3 U	**20**	**13 J**	2.3 U

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**
Location ID					**JVE-314**	**JVE-314**	**JVE-314**	**JVE-314**	**JVE-314**	**JVE-316**
Sample ID					**JVE-314SC-0304-110218**	**JVE-314SC-0405-110218**	**JVE-314SC-0506-110218**	**JVE-314SC-0607-110218**	**JVE-314SC-077.9-110218**	**JVE-316SC-0304-110217**
Sample Date					**2/18/2011**	**2/18/2011**	**2/18/2011**	**2/18/2011**	**2/18/2011**	**2/17/2011**
Depth					**3 - 4 ft**	**4 - 5 ft**	**5 - 6 ft**	**6 - 7 ft**	**7 - 7.9 ft**	**3 - 4 ft**
Sample Type					**N**	**N**	**N**	**N**	**N**	**N**
X					**1275966.80**	**1275966.80**	**1275966.80**	**1275966.80**	**1275966.80**	**1275818.51**
Y					**195235.18**	**195235.18**	**195235.18**	**195235.18**	**195235.18**	**195650.53**
Conventional Parameters (pct)										
Total organic carbon					**0.659**	**0.795**	**0.527**	**0.916**	**0.726**	**1.78**
Total solids					**85.7**	**93**	**86.1**	**84.7**	**80.2**	**72.3**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			2.9 U	3 U	3.6 U	2 U	2.6 U	**87 J**

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Table 1
2011 Sampling Results

				Task	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**	**Jorgensen Forge - Design Subsurface Sediment Sampling**
				Location ID	**JVE-316**	**JVE-316**	**JVE-316**	**JVE-316**	**JVE-316**	**JVE-316**
				Sample ID	**JVE-316SC-0405-110217**	**JVE-316SC-0506-110217**	**JVE-316SC-0607-110217**	**JVE-316SC-0708-110217**	**JVE-316SC-0809-110217**	**JVE-316SC-099.7-110217**
				Sample Date	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**	**2/17/2011**
				Depth	**4 - 5 ft**	**5 - 6 ft**	**6 - 7 ft**	**7 - 8 ft**	**8 - 9 ft**	**9 - 9.7 ft**
				Sample Type	**N**	**N**	**N**	**N**	**N**	**N**
				X	**1275818.51**	**1275818.51**	**1275818.51**	**1275818.51**	**1275818.51**	**1275818.51**
				Y	**195650.53**	**195650.53**	**195650.53**	**195650.53**	**195650.53**	**195650.53**
	SMS_SQS	**SMS_CSL**	**LAET**	**2LAET**						
Conventional Parameters (pct)										
Total organic carbon					**0.734**	**0.254**	**0.323**	**0.111**	**0.151**	**0.119**
Total solids					**80.7**	**82.3**	**77.4**	**83.5**	**85.7**	**81.5**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	19 U	20 U	20 U	20 U	19 U
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			**8**	N/A	N/A	N/A	N/A	N/A

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-320	JVE-320	JVE-320	JVE-320	JVE-320	JVE-320
Sample ID					JVE-320SC-0203-110217	JVE-320SC-0304-110217	JVE-320SC-0405-110217	JVE-320SC-0506-110217	JVE-320SC-0607-110217	JVE-320SC-0708-110217
Sample Date					2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011
Depth					2 - 3 ft	3 - 4 ft	4 - 5 ft	5 - 6 ft	6 - 7 ft	7 - 8 ft
Sample Type					N	N	N	N	N	N
X					1275930.07	1275930.07	1275930.07	1275930.07	1275930.07	1275930.07
Y					195388.02	195388.02	195388.02	195388.02	195388.02	195388.02
Conventional Parameters (pct)										
Total organic carbon					2.95	1.91	2	2.58	2.23	2.29
Total solids					57.6	66.4	59.6	56.8	55.9	56.1
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			60	9	10	1.3	7	3

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET						
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-320	JVE-320	JVE-320	JVE-320	JVE-320	JVE-322
Sample ID					JVE-320SC-0809-110217	JVE-320SC-0910-110217	JVE-320SC-1011-110217	JVE-320SC-1112-110217	JVE-320SC-1212.9-110217	JVE-322SC-0607-110218
Sample Date					2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/17/2011	2/18/2011
Depth					8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12 ft	12 - 12.9 ft	6 - 7 ft
Sample Type					N	N	N	N	N	N
X					1275930.07	1275930.07	1275930.07	1275930.07	1275930.07	1275867.22
Y					195388.02	195388.02	195388.02	195388.02	195388.02	195315.16
Conventional Parameters (pct)										
Total organic carbon					**1.13**	**1.1**	**0.949**	**0.317**	**2.69**	**2.79**
Total solids					**65.7**	**67**	**72.4**	**83.7**	**67.8**	**61.2**
PCB Aroclors (µg/kg)										
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	20 U	N/A	N/A
PCB Aroclors (mg/kg-OC)										
Total PCB Aroclors (U = 0)	12	65			2 U	2 U	2 U	N/A	**2**	**80 J**

Table 1
2011 Sampling Results

	SMS_SQS	SMS_CSL	LAET	2LAET					
Task					Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling	Jorgensen Forge - Design Subsurface Sediment Sampling
Location ID					JVE-322	JVE-322	JVE-322	JVE-322	JVE-322
Sample ID					JVE-322SC-0708-110218	JVE-322SC-0809-110218	JVE-322SC-0910-110218	JVE-322SC-1011-110218	JVE-322SC-1112.4-110218
Sample Date					2/18/2011	2/18/2011	2/18/2011	2/18/2011	2/18/2011
Depth					7 - 8 ft	8 - 9 ft	9 - 10 ft	10 - 11 ft	11 - 12.4 ft
Sample Type					N	N	N	N	N
X					1275867.22	1275867.22	1275867.22	1275867.22	1275867.22
Y					195315.16	195315.16	195315.16	195315.16	195315.16
Conventional Parameters (pct)									
Total organic carbon					**2.06**	**1.86**	**1.94**	**0.932**	**1.88**
Total solids					**62.7**	**72.1**	**80.1**	**86.4**	**77.1**
PCB Aroclors (µg/kg)									
Total PCB Aroclors (U = 0)			130	1000	N/A	N/A	N/A	N/A	N/A
PCB Aroclors (mg/kg-OC)									
Total PCB Aroclors (U = 0)	12	65			**60**	**1.1**	1 U	2 U	1 U

Notes:

Detected concentration is greater than SMS_CSL screening level (yellow)
Detected concentration is greater than SMS_SQS screening level (cyan)
Detected concentration is greater than LAET screening level (green)
Detected concentration is greater than 2LAET screening level (orange)

Bold = Detected result
µg/kg = micrograms per kilogram
mg/kg-OC = milligrams per kilogram organic carbon normalized
CSL = Cleanup Screening Level
ft = feet
J = Estimated value
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
N/A = not applicable
PCB = polychlorinated biphenyls
pct = percent
SMS = Sediment Management Standards
SQS = Sediment Quality Standard
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit

Table 2
Core Collection Coordinates, Mudlines, and Core Lengths

			Coordinates[1]						
			Proposed		Actual				
Station	Date Collected	Date Processed	Easting	Northing	Easting	Northing	Mudline elevation (ft)	Core Length (ft)	% Recovery
JVE-01	2/16/2011	2/18/2011	195767.61	1275751.77	1275754	195763.9	-3.2	9.7	77%
JVE-02	2/16/2011	2/21/2011	195713.12	1275800.18	1275803	195713.4	-1.6	9.6	72%
JVE-03	2/16/2011	2/21/2011	195683.35	1275760.69	1275760	195683.3	-8.3	12.2	91%
JVE-04	2/16/2011	2/21/2011	195672.00	1275802.41	1275803	195674.6	-2.8	9.2	84%
JVE-07	2/16/2011	2/18/2011	195360.20	1275911.45	1275916	195362.3	-5.7	12.2	89%
JVE-205	2/15/2011	2/17/2011	195647.93	1275757.13	1275755	195646.3	-12.8	12.1	91%
JVE-206	3/10/2011	3/16/2011	195605.56	1275810.60	1275802	195613	-10.7	13.6	99%
JVE-207	2/15/2011	2/16/2011	195554.64	1275814.17	1275817	195556.4	-11.5	12.6	92%
JVE-208	3/10/2011	3/16/2011	195510.54	1275850.65	1275835	195513.2	-13.4	12.7	93%
JVE-210	2/15/2011	2/16/2011	195365.23	1275861.23	1275858	195359.4	-14.9	12.7	93%
JVE-215	2/15/2011	2/16/2011	195465.90	1275836.22	1275843	195459.6	-13.4	12.8	98%
JVE-216	2/16/2011	2/18/2011	195183.68	1275931.56	1275929	195180.9	-13.5	12.1	89%
JVE-309	2/15/2011	2/17/2011	195580.00	1275858.00	1275853	195575.6	-4.2	11.5	92%
JVE-311	2/15/2011	2/17/2011	195460.00	1275899.00	1275895	195460.9	-4	9.4	76%
JVE-314	2/16/2011	2/18/2011	195235.00	1275968.00	1275967	195235.2	-4.1	7.9	94%
JVE-316	2/15/2011	2/17/2011	195650.00	1275820.00	1275819	195650.5	-4.3	9.7	75%
JVE-320	2/15/2011	2/17/2011	195387.00	1275927.00	1275930	195388	-2.6	12.9	93%
JVE-322	2/16/2011	2/18/2011	195314.00	1275870.00	1275867	195315.2	-15.4	12.4	92%

Notes:

1 = Coordinates are in NAD83 Washington State Plane North

ft = feet

NAD83 = North American Datum 1983

Table 3

Bottom Elevation, Maximum Bed Shear, and Calculated Stable Particle Sizes

Event Return Period (year)	Range of bottom elevations (feet MLLW)	Maximum bed shear stress (psf)	Stable grain size (mm)
2	-3.4 to -8.4	0.04	3.0
10	-3.4 to -8.4	0.06	5.0
100	-13. 4 to -18.4	0.08	6.0

Notes:
MLLW = mean lower low water
mm = millimeters
psf = pounds per square foot

Table 4
Backfill Material Gradation Specification

U.S. Standard Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	95 - 100
No. 8	80 - 95
No. 16	40 - 70
No. 50	3 - 10
No. 200 wet	0 - 2

Note:
No. = number

Table 5
Backfill Chemical Acceptance Criteria[1]

Parameter	Backfill Levels (mg/kg)
Metals	
Arsenic	13.6
Cadmium	<5.1
Chromium[2]	67.6
Copper	49.9
Lead	250
Mercury	<0.41
Silver	<6.1
Zinc	<410
Organics	
PCBs[3]	< PQL of 0.03
SMS Organics[3]	< SMS SQS/LAET (expressed as dry weight)

Notes:
1. The EPA-approved backfill concentration levels are defined in the EPA letter RE: *Action Memorandum, Responsiveness Summary and Future Actions*, Jorgensen Forge Early Action Area, 8431 East Marginal Way South, Seattle, Washington, Comprehensive Environmental Response, Compensation and Liability Action (CERCLA) Administrative Order on Consent (EPA Docket No. CERCLA-10-2003-001) dated October 7, 2011.
2. See text in Action Memorandum for type of chromium used for this backfill level.
3. The PCBs and SMS SQS are listed as including the dry weight equivalents of the standards because the fill material is expected to contain very little organic carbon, making it inappropriate to carbon normalize the organic concentrations.

EPA = U.S. Environmental Protection Agency
LAET = Lowest Apparent Effects Threshold
mg/kg: milligram per kilogram
PCB = Polychlorinated biphenyl
PQL = Practical Quantitation Limit
SMS = Sediment Management Standard
SQS = Sediment Quality Standard

Table 6
WSDOT Light Loose Riprap Gradation Specification

Size Range	Maximum Size
20% to 90%	300 lbs to 1 ton (2 cubic feet to 1/2 cubic yards)
15% to 80%	50 lbs to 1 ton (1/3 cubic feet to 1/2 cubic yards)
10% to 20%	50 lbs (spalls)

Notes:
lbs = pounds
WSDOT = Washington State Department of Transportation

Table 7
Filter Material Gradation Specification

U.S. Standard Sieve Size	Percent Passing by Weight
4 inch	90–100
3/4 inch	50–75
No. 4	35–55
No. 10	25–45
No. 40	10–25
No. 200	0–4 (wet sieve)

Note:
No. = number

Table 8
Habitat Substrate Material Gradation Specification

U.S. Standard Sieve Size	Percent Passing by Weight
2 1/2 inch	95 – 100
2 inch	70 – 100
1 1/2 inches	40 – 90
1 inch	3 – 30
3/4 inch	15 maximum
No. 200	5 maximum

Note:
No. = number

Table 9
Applicable or Relevant and Appropriate Requirements

Topic	Standard or Requirement	Regulatory Citation: Federal	Regulatory Citation: State	Comment	Compliance
Sediment Quality	Sediment quality standards; cleanup screening levels		Sediment Management Standards (WAC 173-204)	The SMS is a statutory requirement under MTCA and an ARAR under CERCLA. Numerical standards for the protection of benthic marine invertebrates.	As stated in the Action Memo, SMS numerical standards will be fully complied with. The SMS establish a narrative standard with specific biological effects criteria and numerical chemical concentrations for Puget Sound sediment. Under the SMS, the cleanup of a site should result in the elimination of adverse effects on biological resources and any health threats to humans. SMS has numerical standards for biological resources, and narrative standards for protection of human health. Further, the design requires the use of imported "clean" sand, gravel, and rock for backfill and slope containment materials, and the materials will be tested prior to placement.
Fish Tissue Quality	Concentrations of chemicals in fish tissues	Food and Drug Administration Maximum Concentrations of Contaminants in Fish Tissue (49 CFR 10372-10442)		The Washington State Department of Health assesses the need for fish consumption advisories.	The goal for the entire LDW is to meet RAO for reducing human health risks assocaited with consumption of resident LDW seafood. Achieving the RBCs necessary for this RAO may be impossible as the RBCs are more stringent than backgoround. This sediment removal will remove all impacted sediments and replace them with clean fill and will meet all cleanup goals and levels. As indicated in the Action Memo, further fish consumption advisories and/or other measures with respect to the RAB will be re-evaluated in the LDW-wide remedial decision-making process.
Surface Water Quality	Surface Water Quality Standards	Ambient Water Quality Criteria established under Section 304(a) of the Clean Water Act (33 USC 1251 et seq) http://www.epa.gov/ost/criteria/wgctable/	Surface Water Quality Standards (RCW 90-48; WAC 173-201A)	State surface water quality standards apply where the State has adopted and the U.S. Environmental Protection Agency has approved Water Quality Standards Federal recommended Water Quality Criteria established under Section 304(a) of the Clean Water Act that are more stringent than State criteria and that are relevant and appropriate also apply. Both chronic and acute standards, and marine and freshwater are used as appropriate.	WAC 173-201A sets forth water quality standards that must be met in the RAB. The most important standards for slope reconfiguration and containment and sediment dredging and backfill activities are turbidity, dissolved oxygen (DO), and toxic substances limits. These water quality standards must be met at the compliance point established by the water quality certificate.
Land Disposal of Waste	Disposal of materials containing PCBs	Toxic Substances Control Act (15 USC 2605; 40 CFR Part 761)			This regulation is applicable to excavated or dredged materials containing PCBs. The removal action will comply with TSCA by disposing of any soils and/or sediments with total PCB concentrations greater than 50 mg/kg at a TSCA landfill. However, predesign investigations do not indicate that such material exists. Disposal of soils and/or sediments with total PCB concentrations less than 50 mg/kg will follow the substantive requirements of 40 CFR 761.61, cleanup and disposal requirements for PCB remediation waste. Material meeting the definition of PCB remediation waste (761.3) must be disposed of pursuant to one or a combination of the three options under Section 761.61 (self-implementing option; performance-based option, and a risk-based option).
	Hazardous waste	Resource Conservation and Recovery Act Land Disposal Restrictions (42 USC 7401-7642; 40 CFR 268)	Dangerous Waste Regulations Land Disposal Restrictions (RCW 70.105; WAC 173-303, -140, -141)		The upland disposal of dredged contaminated sediments is not exempt from federal and state solid waste management requirements. The requirements of the federal regulations have been incorporated into Ecology's solid waste regulations and the removal action is not anticipated to generate hazardous wastes as defined by Ecology.
Waste Treatment Storage and Disposal		Resource Conservation and Recovery Act (42 USC 7401-7642;40 CFR 264 and 265)	Dangerous Waste Regulations (RCW 70.105; WAC 173-303)		The disposal of dredged sediments in an upland facility where there is no connection to surface water is not exempt from regulation. This exemption has been adopted by Ecology. All dredged material and debris will be transported according to the regulations. All dredged material and debris disposed of in an appropriately permitted upland disposal facility.
Noise	Maximum noise levels		Noise Control Act of 1974 (RCW 80.107; WAC 173-60)		Work will be conducted within the parameters of City of Tukwila noise ordinances.

Table 9
Applicable or Relevant and Appropriate Requirements

Topic	Standard or Requirement	Regulatory Citation: Federal	Regulatory Citation: State	Comment	Compliance
Groundwater		Safe Drinking Water Act MCLs and non-zero MCLGs (40 CFR 141)	RCW 43.20A.165 and WAC 173-290-310	For on-site potable water, if any.	Groundwater beneath the facility is not potable due to marine tidal instrusion per salinity criteria in WAC 173-340-720(2). Drinking water standards are therefore not appropriate; however, groundwater was characterizaed as a potential surface water source. No exceedances have been reported from groundwater sampling in the RAB, with the exception of an anomalous detection from a single monitoring well.
Dredge/Fill and Other In-water Construction Work	Discharge of dredged/fill material into navigable waters or wetlands	Clean Water Act (33 USC 401 et seq; 33 USC 141; 33 USC 1251-1316; 40 CFR 230,231,404; 33 CFR 320-330) Rivers and Harbors Act (33 USC 401 et seq)	Hydraulic Code Rules (RCW 75.20; WAC 220-110)	For in-water dredging, filling or other construction.	The requirements of Section 10 have been addressed by EPA through addressing requirements of Section 404 of the CWA.
	Open-water disposal of dredged sediments	Marine Protection, Research and Sanctuaries Act (33 USC 1401-1445) 40 CFR 227	DMMP (RCW 79.90; WAC 332-30-166)		No open water disposal of dredged sediments in proposed as part of the removal action, therefore this is not applicable.
Solid Waste Disposal	Requirements for solid waste handling management and disposal	Solid Waste Disposal Act (42 USC 215103259-6901-6991; 40 CFR 257,258)	Solid Waste Handling Standards (RCW 70.95; WAC 173-350)		These requirements are applicable to the disposal of non-hazardous waste generated during removal activities. Because the disposal of the dredged sediments and debris will take place in a permitted solid waste landfill that is outside the site boundaries, both substantive and administrative requirements of applicable regulations must be met for this activity. The offsite rule (40 CFR 302.440) of the NCP requires that solid and hazardous waste offsite landfills to which CERCLA hazardous substances are being sent must be acceptable to EPA. The project specifications require the contractor to obtain EPA approval of the proposed disposal facility. The requirements for disposal of dredged sediments will be found in the permit of the landfill that agrees to accept the waste.
Discharge to Surface Water	Point source standards for new discharges to surface water	National Pollutant Discharge Elimination System (40 CFR 122, 125)	Discharge Permit Program (RCW 90.48; WAC 173-216, -222)		The substantive requirements of the state National Pollutant Discharge Elimination System (NPDES) program will be satisfied with EPA's finding that substantive requirements of the CWA 401 Water Quality Certification have been met. The discharge must not cause a violation of surface water quality standards outside the established compliance point.
Shoreline	Construction and development		Shoreline Management Act (RCW 90.58; WAC 173-16); King County Shoreline Master Plan and City of Tukwiilla Zoning Code (KCC Title 25; TMC 18.44)	For construction within 200 feet of the shoreline.	According to SMA regulation WAC 173-27-060, federal agency actions within a coastal county such as King County must be consistent to the maximum extent practicable with the approved Washington state coastal zone management program, subject to certain limitations set forth in the Federal Coastal Zone Management Act, 16 USC. 145 1 et seq. and regulations adopted pursuant to it. Tukwila Municipal Code 18.44 applies to all properties within the shoreline overlay as designated by the Shoreline Management Act at WAC 173-16. The removal of material and slope reconfiguration will improve shoreline conditions and is consistent with applicable regulations.
Floodplain Protection	Avoid adverse impacts, minimize potential harm,	Executive Order 11988, Protection of Flood Plains (40 CFR 6, Appendix A); FEMA National Flood Insurance Program Regulations [44 CFR 60.3Ld][3]).	KCC Title 9, TMC 16.52	For in-water construction activities, including any dredge or fill operations.	The substantive requirements of EO 11988 and 44 CFR 60.3Ld(3) are determination of no net change in the flood elevation as a result of the action. The removal action combined with the slope reconfiguration and containment will result in minimal changes to the bathymetry in the RAB due to the requirement that all dredged areas will be backfilled to grade. The CWA Section 404(b)(1) Evaluation indicates that the removal action will not have any impact on water circulation patterns, flows or currents.
Critical (or Sensitive) Area			Growth Management Act (RCW 37.70a); King County Critical Area Ordinance (KCC Title 21A.24); City of Tukwila (TMC 18.45.020)		The proposed removal action is consistent with the MTCA and the Shoreline ARARs and is therefore substantively compliant with critical area protections; the City of Tukwila designated the Green/Duwamish River environmentally sensitive areas and the implementation of the remedy will result in overall improvements to the LDW.

Table 9
Applicable or Relevant and Appropriate Requirements

Topic	Standard or Requirement	Regulatory Citation		Comment	Compliance
		Federal	State		
Dredge and Fill Requirements		Clean Water Act (Section 404 (b)(1)); 40 CFR 230		CWA regulations at 40 CFR Part 230 set for specific standards to evaluate the proposed placement of dredged or fill material into waters of the United States.	Concurrent with the Final EE/CA, a Section 404(b)(1) evaluation was completed for the project demonstrated that the preferred in-water removal action would be in substantive compliance with the requirements of CWA Section 404
Habitat for and Impacts to Protected Species and Habitats	Evaluate potential species and habitat impacts	U.S. Fish and Wildlife Mitigation Policy (44 FR 7644); U.S. Fish and Wildlife Coordination Act (16 USC 661 et seq); Migratory Bird Treaty Act (16 USC 703); Endangered Species Act (50 CFR 402); Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801); Marine Mammal Protection Act (16 USC 31); Bald and Golden Eagle Protection Act (16 U.S.C. 668)			EPA is consulting with U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Washington Department of Fish and Wildlife regarding potential effects of the removal action of fish and wildlife and measures that would avoid and minimize those impacts. During the removal action, efforts will be taken as needed to protect listed species and their habitat; protect habitat for migratory birds/eagles and avoid disturbances of their nests and eggs; avoid disturbance of marine mammals.
Pretreatment Standards	National Pretreatment Standards		40 CFR Part 403; Metro District Wastewater Discharge Ordinance (KCC) to be considered (as is local requirement)		The substantive requirements of the state National Pollutant Discharge Elimination System program will be satisfied with EPA's finding that substantive requirements of the CWA 401 WAter Quality Certification have been met. The discharge must not cause a violation of surface water quality standards outside the established mixing zone and applicable waterwater discharge requirements under local regulations.
Environmental Impact Review	State Environmental Policy Act		State Environmental Policy Act (RCW 43.21C; WAC 197-11-790)	Applicable to MTCA cleanups.	The proposed removal action is consistent with the MTCA and other ARARs as described above, and is therefore substantively compliant with SEPA

Notes:
ARARs = Applicable or Relevant and Appropriate Requirements
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
DMMP = Dredged Material Management Program
EE/CA = Engineering Evaluation/Cost Analysis
EO = Executive Order
FEMA = Federal Emergency Management Agency
KCC = King County Code
LDW = Lower Duwamish Waterway
MCL = Maximum Containment Level
MTCA = Model Toxics Control Act
NCP = National Contingency Plan
PCBs = polychlorinated biphenyls
RAO = Remedial Action Objective
RBCs = Risk Based Concentration
RCW = Revised Code of Washington
TMC = Tukwila Municipal Code
WAC = Washington Administrative Code
USC = United States Code
SMC = Seattle Municipal Code
SMS = Sediment Management Standards

FIGURES

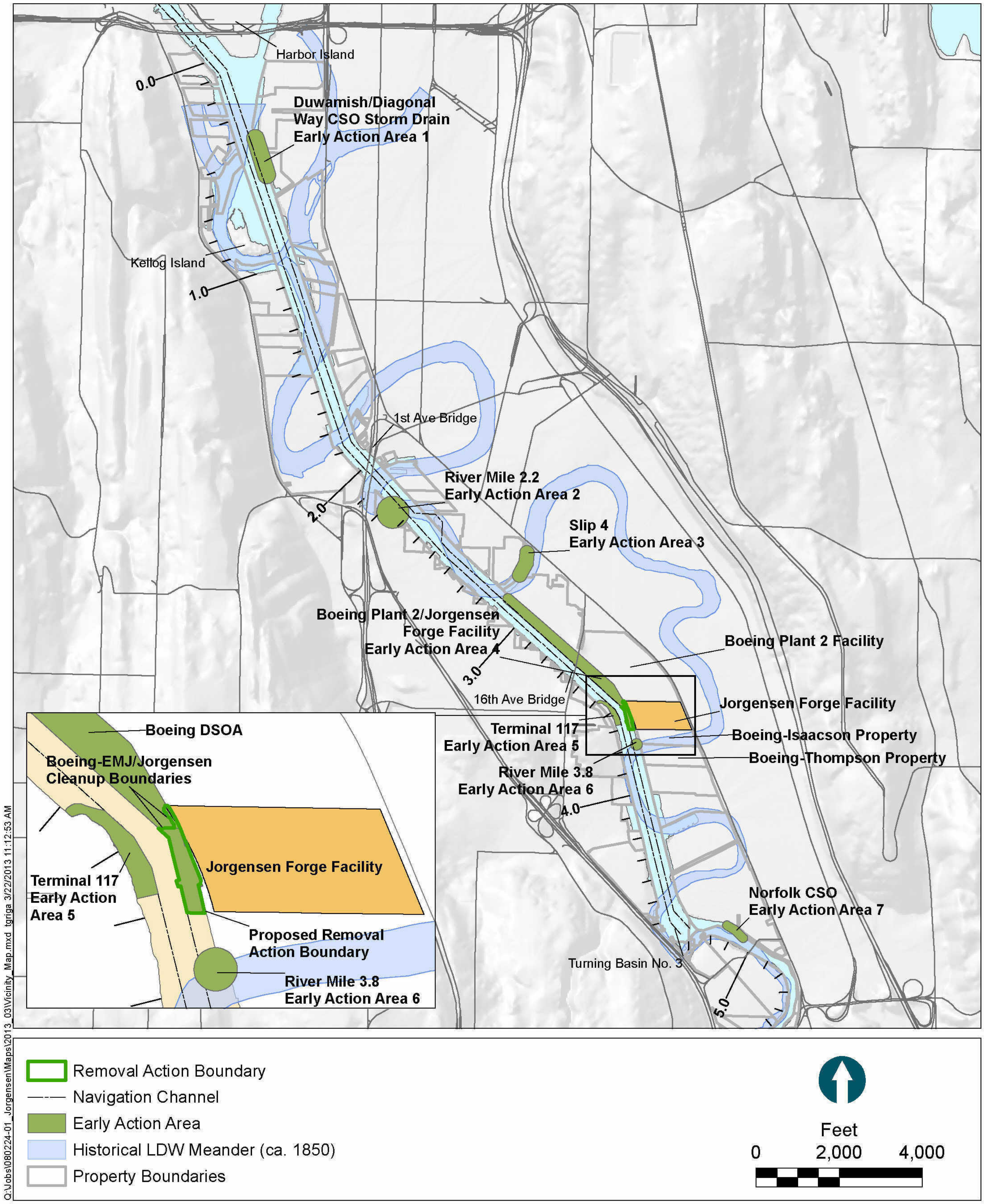

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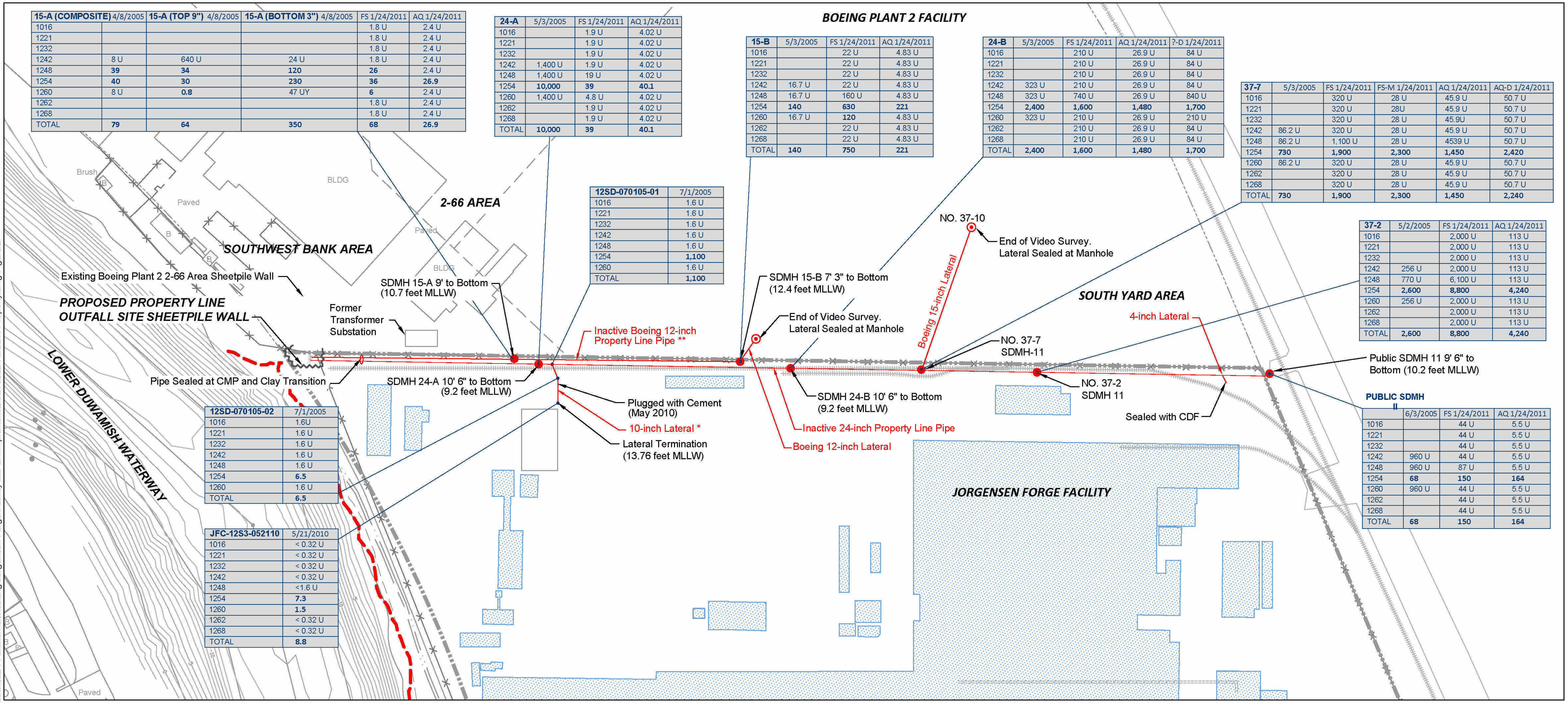
Figure 1
Removal Action Vicinity Map
Basis of Design Report
Jorgensen Forge Early Action Area



15-A (COMPOSITE)	4/8/2005	15-A (TOP 9") 4/8/2005	15-A (BOTTOM 3") 4/8/2005	FS 1/24/2011	AQ 1/24/2011
1016				1.8 U	2.4 U
1221				1.8 U	2.4 U
1232				1.8 U	2.4 U
1242	8 U	640 U	24 U	1.8 U	2.4 U
1248	**39**	**34**	**120**	**26**	2.4 U
1254	**40**	**30**	**230**	**36**	**26.9**
1260	8 U	**0.8**	47 UY	**6**	2.4 U
1262				1.8 U	2.4 U
1268				1.8 U	2.4 U
TOTAL	**79**	**64**	**350**	**68**	**26.9**

24-A	5/3/2005	FS 1/24/2011	AQ 1/24/2011
1016		1.9 U	4.02 U
1221		1.9 U	4.02 U
1232		1.9 U	4.02 U
1242	1,400 U	1.9 U	4.02 U
1248	1,400 U	19 U	4.02 U
1254	**10,000**	**39**	**40.1**
1260	1,400 U	4.8 U	4.02 U
1262		1.9 U	4.02 U
1268		1.9 U	4.02 U
TOTAL	**10,000**	**39**	**40.1**

12SD-070105-01	7/1/2005
1016	1.6 U
1221	1.6 U
1232	1.6 U
1242	1.6 U
1248	1.6 U
1254	**1,100**
1260	1.6 U
TOTAL	**1,100**

15-B	5/3/2005	FS 1/24/2011	AQ 1/24/2011
1016		22 U	4.83 U
1221		22 U	4.83 U
1232		22 U	4.83 U
1242	16.7 U	22 U	4.83 U
1248	16.7 U	160 U	4.83 U
1254	**140**	**630**	**221**
1260	16.7 U	**120**	4.83 U
1262		22 U	4.83 U
1268		22 U	4.83 U
TOTAL	**140**	**750**	**221**

24-B	5/3/2005	FS 1/24/2011	AQ 1/24/2011	?-D 1/24/2011
1016		210 U	26.9 U	84 U
1221		210 U	26.9 U	84 U
1232		210 U	26.9 U	84 U
1242	323 U	210 U	26.9 U	84 U
1248	323 U	740 U	26.9 U	840 U
1254	**2,400**	**1,600**	**1,480**	**1,700**
1260	323 U	210 U	26.9 U	210 U
1262		210 U	26.9 U	84 U
1268		210 U	26.9 U	84 U
TOTAL	**2,400**	**1,600**	**1,480**	**1,700**

37-7	5/3/2005	FS 1/24/2011	FS-M 1/24/2011	AQ 1/24/2011	AQ-D 1/24/2011
1016		320 U	28 U	45.9 U	50.7 U
1221		320 U	28U	45.9 U	50.7 U
1232		320 U	28 U	45.9U	50.7 U
1242	86.2 U	320 U	28 U	45.9 U	50.7 U
1248	86.2 U	1,100 U	28 U	4539 U	50.7 U
1254	**730**	**1,900**	**2,300**	**1,450**	**2,420**
1260	86.2 U	320 U	28 U	45.9 U	50.7 U
1262		320 U	28 U	45.9 U	50.7 U
1268		320 U	28 U	45.9 U	50.7 U
TOTAL	**730**	**1,900**	**2,300**	**1,450**	**2,240**

37-2	5/2/2005	FS 1/24/2011	AQ 1/24/2011
1016		2,000 U	113 U
1221		2,000 U	113 U
1232		2,000 U	113 U
1242	256 U	2,000 U	113 U
1248	770 U	6,100 U	113 U
1254	**2,600**	**8,800**	**4,240**
1260	256 U	2,000 U	113 U
1262		2,000 U	113 U
1268		2,000 U	113 U
TOTAL	**2,600**	**8,800**	**4,240**

PUBLIC SDMH II

	6/3/2005	FS 1/24/2011	AQ 1/24/2011
1016		44 U	5.5 U
1221		44 U	5.5 U
1232		44 U	5.5 U
1242	960 U	44 U	5.5 U
1248	960 U	87 U	5.5 U
1254	**68**	**150**	**164**
1260	960 U	44 U	5.5 U
1262		44 U	5.5 U
1268		44 U	5.5 U
TOTAL	**68**	**150**	**164**

12SD-070105-02	7/1/2005
1016	1.6U
1221	1.6 U
1232	1.6 U
1242	1.6 U
1248	1.6 U
1254	**6.5**
1260	1.6 U
TOTAL	**6.5**

JFC-12S3-052110	5/21/2010
1016	< 0.32 U
1221	< 0.32 U
1232	< 0.32 U
1242	< 0.32 U
1248	<1.6 U
1254	**7.3**
1260	**1.5**
1262	< 0.32 U
1268	< 0.32 U
TOTAL	**8.8**

LEGEND:

SDMH 15A — Manhole Location Sealed with CDF in February of 2011

NO. 37-10 — Unsealed Manhole Location

10' 6" to Bottom — Feet to Bottom of Pipe

(10.7 feet MLLW) — Conversion to MLLW (Mean Lower Low Water)

Property Boundary

Railroad Spur

Fence

Current Facility Structures

* Formerly Referred to as '12-Inch Lateral'

** Formerly Referred to as 'Boeing 15-Inch Property Line Pipe'

Sample ID	Sample Date
PCB Aroclor	Concentration (mg/kg)

BOLD Detected PCB Aroclor Concentration

U No Detectable Aroclor Concentrations Above the Listed Laboratory Reporting Limit

Y Analyte Reporting Limit is Raised Due to a Positive Chromatographic Interference. The Compound is Not Detected Above the Raised Limit but may be Present At or Below the Limit

FS Floyd Snider Sample

AQ Anchor QEA Split Sample

D Duplicate Sample

Toe of Existing Riprap

SOURCE: Prepared from drawing provided by Farallon Consulting dated April 15, 2008.

NOTES:

1. All shown PCB concentrations are associated with solids sampled collected from bottom of Property Line Pipe at manhole locations shown on map.
2. Buildings and are not geo-referenced.
3. All Aroclor results in milligrams per kilogram (mg/kg).

HORIZONTAL DATUM: Washington State Plane North, NAD83.

0 140
Scale in Feet

K:\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Property.dwg Figure 2

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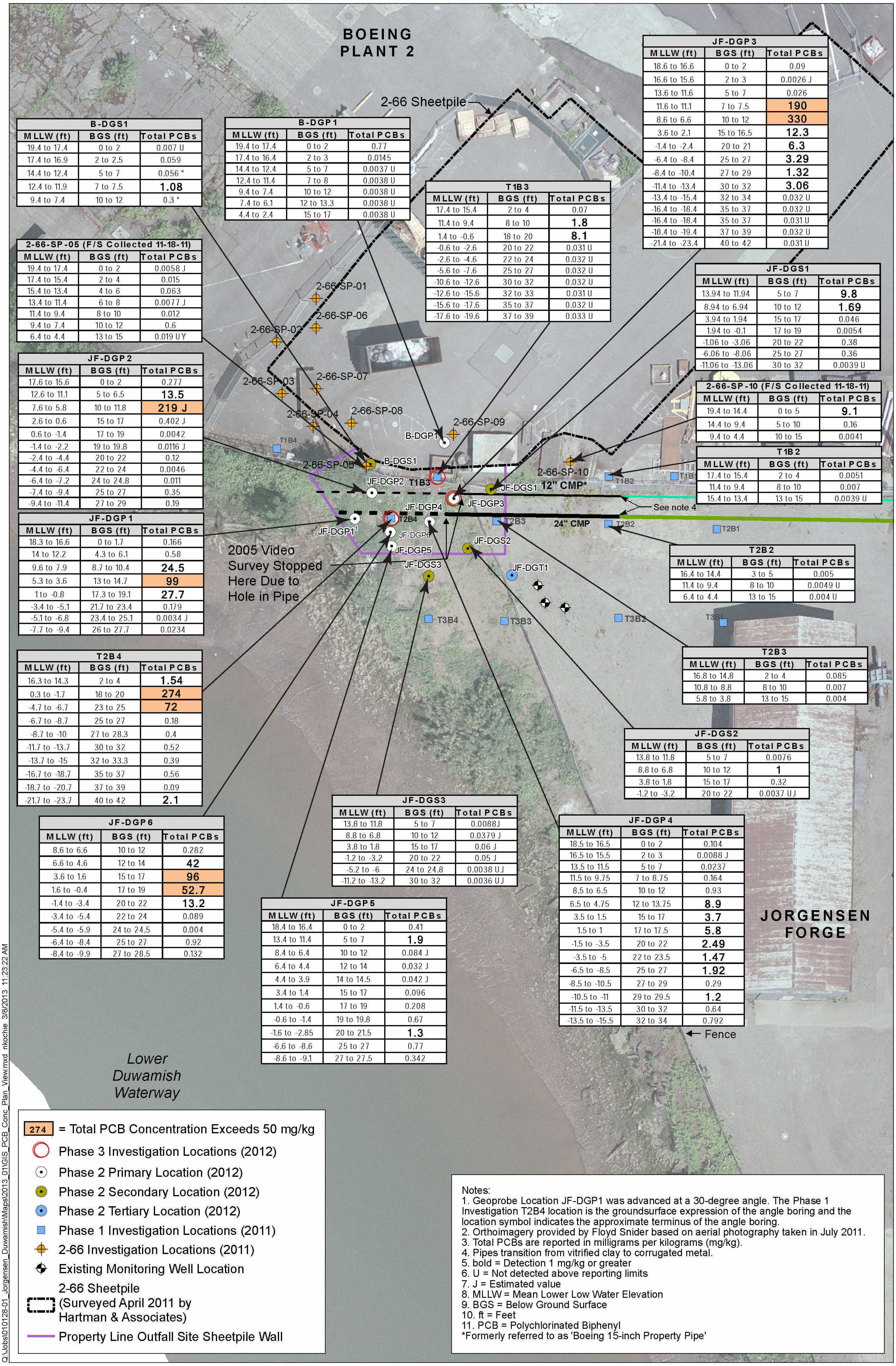
Figure 2
Property Line Pipe/Manhole Solids PCB Concentrations
Basis of Design Report
Jorgensen Forge Early Action Area



B-DGS1

MLLW (ft)	BGS (ft)	Total PCBs
19.4 to 17.4	0 to 2	0.007 U
17.4 to 16.9	2 to 2.5	0.059
14.4 to 12.4	5 to 7	0.056 *
12.4 to 11.9	7 to 7.5	**1.08**
9.4 to 7.4	10 to 12	0.3 *

B-DGP1

MLLW (ft)	BGS (ft)	Total PCBs
19.4 to 17.4	0 to 2	0.77
17.4 to 16.4	2 to 3	0.0145
14.4 to 12.4	5 to 7	0.0037 U
12.4 to 11.4	7 to 8	0.0038 U
9.4 to 7.4	10 to 12	0.0038 U
7.4 to 6.1	12 to 13.3	0.0038 U
4.4 to 2.4	15 to 17	0.0038 U

JF-DGP3

MLLW (ft)	BGS (ft)	Total PCBs
18.6 to 16.6	0 to 2	0.09
16.6 to 15.6	2 to 3	0.0026 J
13.6 to 11.6	5 to 7	0.026
11.6 to 11.1	7 to 7.5	**190**
8.6 to 6.6	10 to 12	**330**
3.6 to 2.1	15 to 16.5	**12.3**
-1.4 to -2.4	20 to 21	**6.3**
-6.4 to -8.4	25 to 27	**3.29**
-8.4 to -10.4	27 to 29	**1.32**
-11.4 to -13.4	30 to 32	**3.06**
-13.4 to -15.4	32 to 34	0.032 U
-16.4 to -18.4	35 to 37	0.032 U
-16.4 to -18.4	35 to 37	0.031 U
-18.4 to -19.4	37 to 39	0.032 U
-21.4 to -23.4	40 to 42	0.031 U

T1B3

MLLW (ft)	BGS (ft)	Total PCBs
17.4 to 15.4	2 to 4	0.07
11.4 to 9.4	8 to 10	**1.8**
1.4 to -0.6	18 to 20	**8.1**
-0.6 to -2.6	20 to 22	0.031 U
-2.6 to -4.6	22 to 24	0.032 U
-5.6 to -7.6	25 to 27	0.032 U
-10.6 to -12.6	30 to 32	0.032 U
-12.6 to -15.6	32 to 33	0.031 U
-15.6 to -17.6	35 to 37	0.032 U
-17.6 to -19.6	37 to 39	0.033 U

2-66-SP-05 (F/S Collected 11-18-11)

MLLW (ft)	BGS (ft)	Total PCBs
19.4 to 17.4	0 to 2	0.0058 J
17.4 to 15.4	2 to 4	0.015
15.4 to 13.4	4 to 6	0.063
13.4 to 11.4	6 to 8	0.0077 J
11.4 to 9.4	8 to 10	0.012
9.4 to 7.4	10 to 12	0.6
6.4 to 4.4	13 to 15	0.019 UY

JF-DGS1

MLLW (ft)	BGS (ft)	Total PCBs
13.94 to 11.94	5 to 7	**9.8**
8.94 to 6.94	10 to 12	**1.69**
3.94 to 1.94	15 to 17	0.046
1.94 to -0.1	17 to 19	0.0054
-1.06 to -3.06	20 to 22	0.38
-6.06 to -8.06	25 to 27	0.36
-11.06 to -13.06	30 to 32	0.0039 U

JF-DGP2

MLLW (ft)	BGS (ft)	Total PCBs
17.6 to 15.6	0 to 2	0.277
12.6 to 11.1	5 to 6.5	**13.5**
7.6 to 5.8	10 to 11.8	**219 J**
2.6 to 0.6	15 to 17	0.402 J
0.6 to -1.4	17 to 19	0.0042
-1.4 to -2.2	19 to 19.8	0.0116 J
-2.4 to -4.4	20 to 22	0.12
-4.4 to -6.4	22 to 24	0.0046
-6.4 to -7.2	24 to 24.8	0.011
-7.4 to -9.4	25 to 27	0.35
-9.4 to -11.4	27 to 29	0.19

2-66-SP-10 (F/S Collected 11-18-11)

MLLW (ft)	BGS (ft)	Total PCBs
19.4 to 14.4	0 to 5	**9.1**
14.4 to 9.4	5 to 10	0.16
9.4 to 4.4	10 to 15	0.0041

T1B2

MLLW (ft)	BGS (ft)	Total PCBs
17.4 to 15.4	2 to 4	0.0051
11.4 to 9.4	8 to 10	0.007
15.4 to 13.4	13 to 15	0.0039 U

JF-DGP1

MLLW (ft)	BGS (ft)	Total PCBs
18.3 to 16.6	0 to 1.7	0.166
14 to 12.2	4.3 to 6.1	0.58
9.6 to 7.9	8.7 to 10.4	**24.5**
5.3 to 3.6	13 to 14.7	**99**
1 to -0.8	17.3 to 19.1	**27.7**
-3.4 to -5.1	21.7 to 23.4	0.179
-5.1 to -6.8	23.4 to 25.1	0.0034 J
-7.7 to -9.4	26 to 27.7	0.0234

T2B2

MLLW (ft)	BGS (ft)	Total PCBs
16.4 to 14.4	3 to 5	0.005
11.4 to 9.4	8 to 10	0.0049 U
6.4 to 4.4	13 to 15	0.004 U

T2B4

MLLW (ft)	BGS (ft)	Total PCBs
16.3 to 14.3	2 to 4	**1.54**
0.3 to -1.7	18 to 20	**274**
-4.7 to -6.7	23 to 25	**72**
-6.7 to -8.7	25 to 27	0.18
-8.7 to -10	27 to 28.3	0.4
-11.7 to -13.7	30 to 32	0.52
-13.7 to -15	32 to 33.3	0.39
-16.7 to -18.7	35 to 37	0.56
-18.7 to -20.7	37 to 39	0.09
-21.7 to -23.7	40 to 42	**2.1**

T2B3

MLLW (ft)	BGS (ft)	Total PCBs
16.8 to 14.8	2 to 4	0.085
10.8 to 8.8	8 to 10	0.007
5.8 to 3.8	13 to 15	0.004

JF-DGS2

MLLW (ft)	BGS (ft)	Total PCBs
13.8 to 11.8	5 to 7	0.0076
8.8 to 6.8	10 to 12	**1**
3.8 to 1.8	15 to 17	0.32
-1.2 to -3.2	20 to 22	0.0037 UJ

JF-DGS3

MLLW (ft)	BGS (ft)	Total PCBs
13.8 to 11.8	5 to 7	0.0088J
8.8 to 6.8	10 to 12	0.0379 J
3.8 to 1.8	15 to 17	0.06 J
-1.2 to -3.2	20 to 22	0.05 J
-5.2 to -6	24 to 24.8	0.0038 UJ
-11.2 to -13.2	30 to 32	0.0036 UJ

JF-DGP6

MLLW (ft)	BGS (ft)	Total PCBs
8.6 to 6.6	10 to 12	0.282
6.6 to 4.6	12 to 14	**42**
3.6 to 1.6	15 to 17	**96**
1.6 to -0.4	17 to 19	**52.7**
-1.4 to -3.4	20 to 22	**13.2**
-3.4 to -5.4	22 to 24	0.089
-5.4 to -5.9	24 to 24.5	0.004
-6.4 to -8.4	25 to 27	0.92
-8.4 to -9.9	27 to 28.5	0.132

JF-DGP5

MLLW (ft)	BGS (ft)	Total PCBs
18.4 to 16.4	0 to 2	0.41
13.4 to 11.4	5 to 7	**1.9**
8.4 to 6.4	10 to 12	0.084 J
6.4 to 4.4	12 to 14	0.032 J
4.4 to 3.9	14 to 14.5	0.042 J
3.4 to 1.4	15 to 17	0.096
1.4 to -0.6	17 to 19	0.208
-0.6 to -1.4	19 to 19.8	0.67
-1.6 to -2.85	20 to 21.5	**1.3**
-6.6 to -8.6	25 to 27	0.77
-8.6 to -9.1	27 to 27.5	0.342

JF-DGP4

MLLW (ft)	BGS (ft)	Total PCBs
18.5 to 16.5	0 to 2	0.104
16.5 to 15.5	2 to 3	0.0088 J
13.5 to 11.5	5 to 7	0.0237
11.5 to 9.75	7 to 8.75	0.164
8.5 to 6.5	10 to 12	0.93
6.5 to 4.75	12 to 13.75	**8.9**
3.5 to 1.5	15 to 17	**3.7**
1.5 to 1	17 to 17.5	**5.8**
-1.5 to -3.5	20 to 22	**2.49**
-3.5 to -5	22 to 23.5	**1.47**
-6.5 to -8.5	25 to 27	**1.92**
-8.5 to -10.5	27 to 29	0.29
-10.5 to -11	29 to 29.5	**1.2**
-11.5 to -13.5	30 to 32	0.64
-13.5 to -15.5	32 to 34	0.792

Notes:
1. Geoprobe Location JF-DGP1 was advanced at a 30-degree angle. The Phase 1 Investigation T2B4 location is the groundsurface expression of the angle boring and the location symbol indicates the approximate terminus of the angle boring.
2. Orthoimagery provided by Floyd Snider based on aerial photography taken in July 2011.
3. Total PCBs are reported in milligrams per kilograms (mg/kg).
4. Pipes transition from vitrified clay to corrugated metal.
5. bold = Detection 1 mg/kg or greater
6. U = Not detected above reporting limits
7. J = Estimated value
8. MLLW = Mean Lower Low Water Elevation
9. BGS = Below Ground Surface
10. ft = Feet
11. PCB = Polychlorinated Biphenyl
*Formerly referred to as 'Boeing 15-inch Property Pipe'

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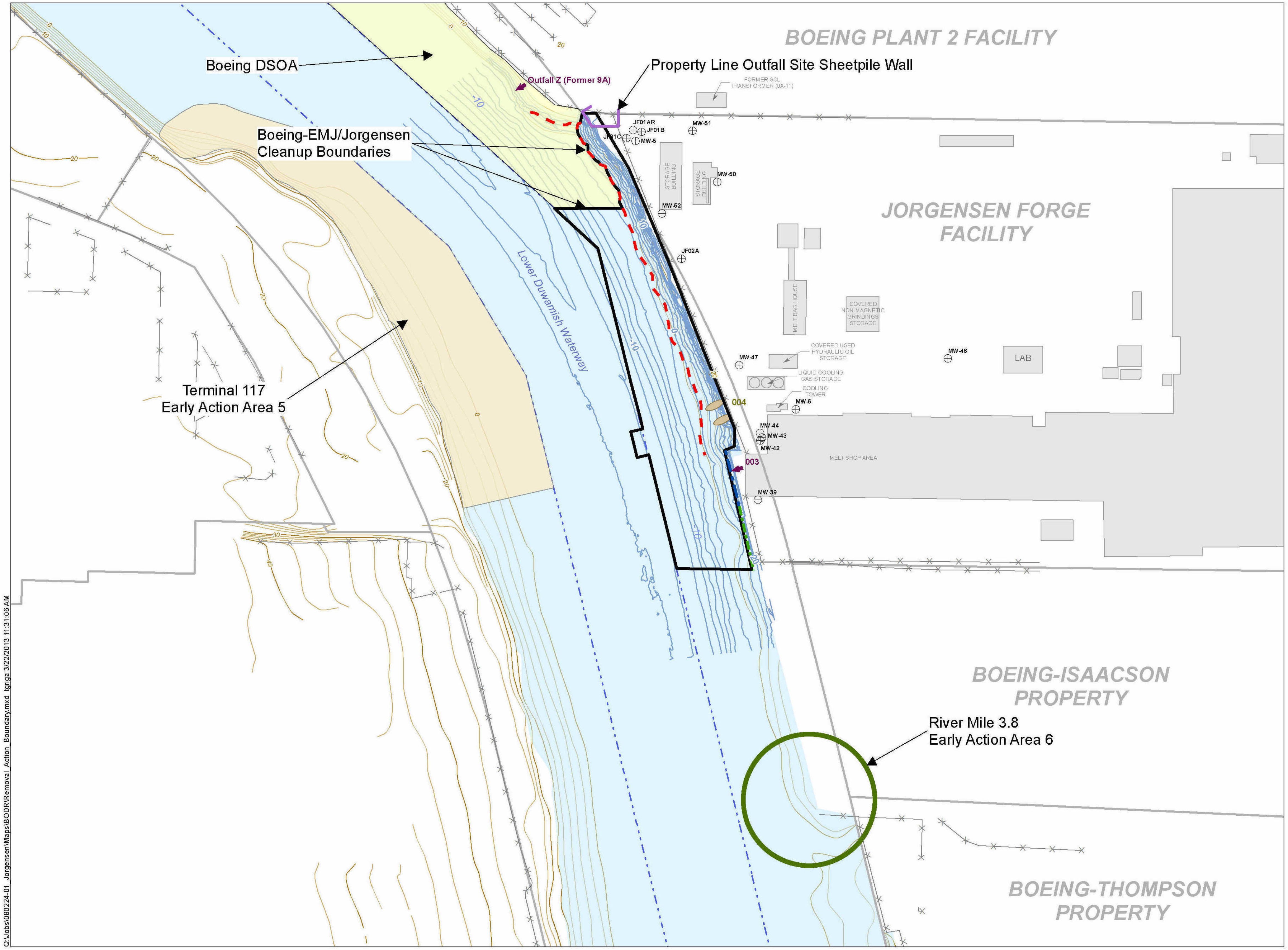
Figure 3
Soil Total PCB Concentrations
Basis of Design Report
Jorgensen Forge Early Action Area



LEGEND

- Groundwater Monitoring Well
- Active Outfall
- Toe of Existing Riprap
- Existing Sheetpile Wall
- Existing Concrete Panel Wall
- Fences
- Federal Navigation Channel
- Removal Action Boundary
- Debris Pile
- Property Boundaries
- Boeing DSOA
- Terminal 117 Early Action Area 5 Boundary
- Property Line Outfall Site Sheetpile Wall

NOTES:

1. Bathymetric survey by eTrac dated February 8, 2012. Additional back survey by AEC Consultants, Inc. dated February 21, 2012. Bathymetric and bank survey merged with upland survey by PLS, Inc. dated January 24, 2012.

2. Outfall locations field identified on May 14, 2003.

3. The toe of riprap slope was surveyed during a low tide on August 28, 2008.

4. The Boeing-EMJ/Jorgensen cleanup boundaries are identified in the Memorandum of Understanding between Boeing and EMJ/Jorgensen Forge, dated August 2007 (EMJ et al. 2007).

Feet

0 80 160 240 320

Q:\Jobs\080224-01_Jorgensen\Maps\BODR\Removal_Action_Boundary.mxd tgriga 3/22/2013 11:31:06 AM

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Figure 4
Removal Action Boundary
Basis of Design Report
Jorgensen Forge Early Action Area

Boeing Unidentified 3 (Inactive)	
Diameter	4 inch
Elevation	unknown

Boeing Unidentified 2 (Inactive)	
Diameter	2 inch
Elevation	unknown

Boeing Outfall Y (Former 10; Inactive)	
Diameter	18 inch
Elevation	7.5 ft MLLW

Boeing Outfall Z (Former 9A; Active)	
Diameter	36 inch
Elevation	7.43 ft MLLW

Boeing Outfall 9 (Inactive)	
Diameter	2 inch
Elevation	unknown

Approximate Location of Boeing Plant 2 Property Line

Inactive 24-inch PL Outfall & Boeing 12-inch* PL Outfall	
Diameter	24 inch
Elevation	unknown

Boeing Duwamish Sediment Other Area Shoreline

Removal Action Boundary Shoreline

Downstream

NOTES:

1. Survey completed on May 14, 2003 during approximately -1 feet MLLW water surface elevation.
2. Boeing-EMJ/Jorgensen In-Water Cleanup Boundary identified in MOU (EMJ et al. 2007).

* Formerly referred to as 'Boeing 15-inch Property Line Pipe'

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Figure 5a
Outfall and Shoreline Reconnaissance Photolog - Northern Shoreline
Basis of Design Report
Jorgensen Forge Early Action Area

Outfall 009 (Inactive)	
Diameter	3 inch
Elevation	18.12 ft MLLW

B C

Removal Action Boundary Shoreline

Approximate Location of
Boeing-EMJ/Jorgensen In-Water Cleanup Boundary

Outfall 008 (Inactive)	
Diameter	11.5 inch
Elevation	10.6 ft MLLW

Outfall 007 (Inactive)	
Diameter	4.75 inch
Elevation	17.69 ft MLLW

C D

Removal Action Boundary Shoreline

← Downstream

NOTES:
1. Survey completed on May 14, 2003 during approximately -1 feet MLLW water surface elevation.

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Figure 5b
Outfall and Shoreline Reconnaissance Photolog - Central Shoreline
Basis of Design Report
Jorgensen Forge Early Action Area

Outfall 006 (Inactive)	
Diameter	4.75 inch
Elevation	17.55 ft MLLW

Outfall 005 (Inactive)	
Diameter	12 inch
Elevation	8.88 ft MLLW

Outfall 004 (Inactive)	
Diameter	12 inch
Elevation	6.99 ft MLLW

D

E

Removal Action Boundary Shoreline

Outfall 003 (Active)	
Diameter	18 inch
Elevation	8.91 ft MLLW
NPDES SW Permit	#WAR-00321

Sheetpile Wall

Outfall 002 (Inactive)	
Diameter	12 inch
Elevation	9.04 ft MLLW

Concrete Panel Wall

Outfall 001 (Inactive)	
Diameter	12 inch
Elevation	12.42 ft MLLW

E

Removal Action Boundary Shoreline

Mudflat

Approximate Location of
The Boeing / Isaacson
Property Line

Downstream

NOTES:
1. Survey completed on May 14, 2003 during approximately -1 feet MLLW water surface elevation.

\\Galatcad\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Photolog.dwg Figure 5c

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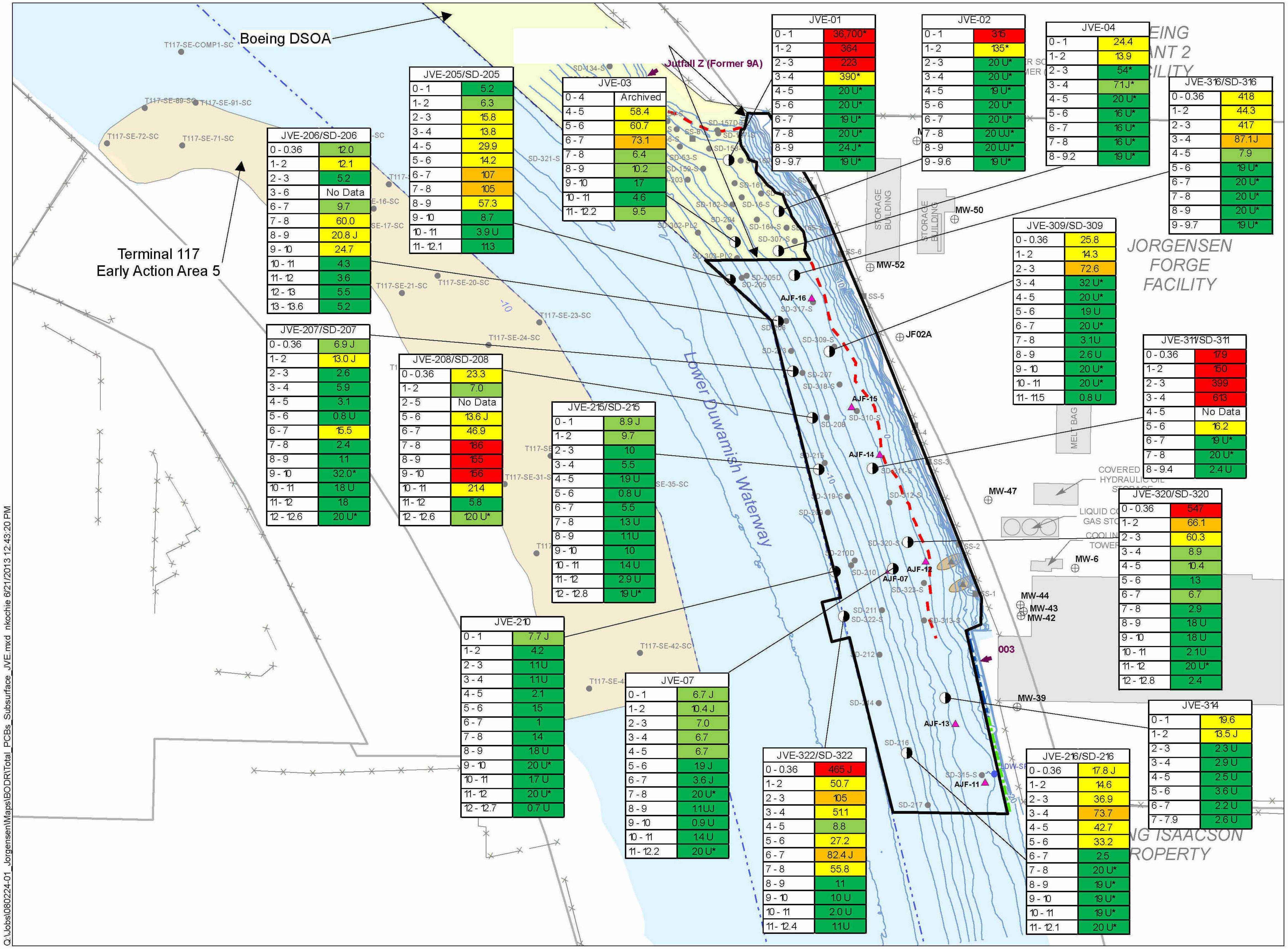
ANCHOR QEA

Figure 5c
Outfall and Shoreline Reconnaissance Photolog - Southern Shoreline
Basis of Design Report
Jorgensen Forge Early Action Area



JVE-01	
0 - 1	36,700*
1 - 2	364
2 - 3	223
3 - 4	390*
4 - 5	20 U*
5 - 6	20 U*
6 - 7	19 U*
7 - 8	20 U*
8 - 9	24 J*
9 - 9.7	19 U*

JVE-02	
0 - 1	315
1 - 2	135*
2 - 3	20 U*
3 - 4	20 U*
4 - 5	19 U*
5 - 6	20 U*
6 - 7	20 U*
7 - 8	20 UJ*
8 - 9	20 UJ*
9 - 9.6	19 U*

JVE-04	
0 - 1	24.4
1 - 2	13.9
2 - 3	54*
3 - 4	71 J*
4 - 5	20 U*
5 - 6	16 U*
6 - 7	16 U*
7 - 8	16 U*
8 - 9.2	19 U*

JVE-316/SD-316	
0 - 0.36	41.8
1 - 2	44.3
2 - 3	41.7
3 - 4	87.1 J
4 - 5	7.9
5 - 6	19 U*
6 - 7	20 U*
7 - 8	20 U*
8 - 9	20 U*
9 - 9.7	19 U*

JVE-03	
0 - 4	Archived
4 - 5	58.4
5 - 6	60.7
6 - 7	73.1
7 - 8	6.4
8 - 9	10.2
9 - 10	1.7
10 - 11	4.6
11 - 12.2	9.5

JVE-205/SD-205	
0 - 1	5.2
1 - 2	6.3
2 - 3	15.8
3 - 4	13.8
4 - 5	29.9
5 - 6	14.2
6 - 7	107
7 - 8	105
8 - 9	57.3
9 - 10	8.7
10 - 11	3.9 U
11 - 12.1	11.3

JVE-206/SD-206	
0 - 0.36	12.0
1 - 2	12.1
2 - 3	5.2
3 - 6	No Data
6 - 7	9.7
7 - 8	60.0
8 - 9	20.8 J
9 - 10	24.7
10 - 11	4.3
11 - 12	3.6
12 - 13	5.5
13 - 13.6	5.2

JVE-207/SD-207	
0 - 0.36	6.9 J
1 - 2	13.0 J
2 - 3	2.6
3 - 4	5.9
4 - 5	3.1
5 - 6	0.8 U
6 - 7	15.5
7 - 8	2.4
8 - 9	1.1
9 - 10	32.0*
10 - 11	1.8 U
11 - 12	1.8
12 - 12.6	20 U*

JVE-208/SD-208	
0 - 0.36	23.3
1 - 2	7.0
2 - 5	No Data
5 - 6	13.6 J
6 - 7	46.9
7 - 8	186
8 - 9	155
9 - 10	156
10 - 11	21.4
11 - 12	5.8
12 - 12.6	120 U*

JVE-215/SD-215	
0 - 1	8.9 J
1 - 2	9.7
2 - 3	1.0
3 - 4	5.5
4 - 5	1.9 U
5 - 6	0.8 U
6 - 7	5.5
7 - 8	1.3 U
8 - 9	1.1 U
9 - 10	1.0
10 - 11	1.4 U
11 - 12	2.9 U
12 - 12.8	19 U*

JVE-309/SD-309	
0 - 0.36	25.8
1 - 2	14.3
2 - 3	72.6
3 - 4	32 U*
4 - 5	20 U*
5 - 6	1.9 U
6 - 7	20 U*
7 - 8	3.1 U
8 - 9	2.6 U
9 - 10	20 U*
10 - 11	20 U*
11 - 11.5	0.8 U

JVE-311/SD-311	
0 - 0.36	179
1 - 2	150
2 - 3	399
3 - 4	613
4 - 5	No Data
5 - 6	16.2
6 - 7	19 U*
7 - 8	20 U*
8 - 9.4	2.4 U

JVE-320/SD-320	
0 - 0.36	547
1 - 2	66.1
2 - 3	60.3
3 - 4	8.9
4 - 5	10.4
5 - 6	1.3
6 - 7	6.7
7 - 8	2.9
8 - 9	1.8 U
9 - 10	1.8 U
10 - 11	2.1 U
11 - 12	20 U*
12 - 12.8	2.4

JVE-210	
0 - 1	7.7 J
1 - 2	4.2
2 - 3	1.1 U
3 - 4	1.1 U
4 - 5	2.1
5 - 6	1.5
6 - 7	1
7 - 8	1.4
8 - 9	1.8 U
9 - 10	20 U*
10 - 11	1.7 U
11 - 12	20 U*
12 - 12.7	0.7 U

JVE-07	
0 - 1	6.7 J
1 - 2	10.4 J
2 - 3	7.0
3 - 4	6.7
4 - 5	6.7
5 - 6	1.9 J
6 - 7	3.6 J
7 - 8	20 U*
8 - 9	1.1 UJ
9 - 10	0.9 U
10 - 11	1.4 U
11 - 12.2	20 U*

JVE-322/SD-322	
0 - 0.36	465 J
1 - 2	50.7
2 - 3	105
3 - 4	51.1
4 - 5	8.8
5 - 6	27.2
6 - 7	82.4 J
7 - 8	55.8
8 - 9	1.1
9 - 10	1.0 U
10 - 11	2.0 U
11 - 12.4	1.1 U

JVE-216/SD-216	
0 - 0.36	17.8 J
1 - 2	14.6
2 - 3	36.9
3 - 4	73.7
4 - 5	42.7
5 - 6	33.2
6 - 7	2.5
7 - 8	20 U*
8 - 9	19 U*
9 - 10	19 U*
10 - 11	19 U*
11 - 12.1	20 U*

JVE-314	
0 - 1	19.6
1 - 2	13.5 J
2 - 3	2.3 U
3 - 4	2.9 U
4 - 5	2.5 U
5 - 6	3.6 U
6 - 7	2.2 U
7 - 7.9	2.6 U

Total PCBs[1]

- Less than 0.5x SQS/ LAET
- Between 0.5x SQS/ LAET to SQS/ LAET
- Between SQS/ LAET to CSL/ LAET
- Between CSL/ LAET to 2x CSL/ LAET
- Greater than 2x CSL/ LAET
- Non-detected Concentrations greater than SQS

JVE-04	
0 - 1	24.4
1 - 2	13.9
2 - 3	54*
3 - 4	71*

- JVE-04 — Subsurface Core Station ID
- PCB Concentration (mg/kg-OC)
- * PCB Concentration (µg/kg) for TOC value was greater than 0.5% or less than 3%
- Depth Interval in feet

LEGEND

- Vertical Extent Sampling Location (Anchor, 2011)
- Subsurface Samples (Anchor, 2005)
- Subsurface Sampling Locations (others)
- Shoreline (0-2 ft) Bank Samples (Farallon, 2004)
- Debris Pile Samples (Farallon, 2004)
- Seep Sampling Location (Windward, 2004b)
- Groundwater Monitoring Well
- Active Outfall
- Existing Concrete Panel Wall
- Toe of Existing Riprap
- Existing Sheetpile Wall
- Fences
- Federal Channel
- Removal Action Boundary
- Debris Pile
- Property Boundaries
- Boeing DSOA
- Terminal 117 Early Action Area 5 Boundary

NOTES:

1. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
*TOC value was <0.5% or > 3%; reported in µg/kg dry weight.

2. Bathymetric survey by eTrac dated February 8, 2012. Additional back survey by AEC Consultants, Inc. dated February 21, 2012. Bathymetric and bank survey merged with upland survey by PLS, Inc. dated January 24, 2012.

3. Outfall locations field identified on May 14, 2003.

4. The toe of existing riprap slope was surveyed during a low tide on August 28, 2008.

5. The Boeing-EMJ/Jorgensen cleanup boundaries are identified in the Memorandum of Understanding between Boeing and EMJ/Jorgensen Forge, dated August 2007 (EMJ et al. 2007).

6. Sediment Quality Standard (SQS) = 12 mg/kg-OC.

7. Lower Apparent Effects Threshold (LAET) = 0.13 mg/kg.

8. Cleanup Screening Level (CSL) = 65 mg/kg-OC.

9. Second Lower Apparent Effects Threshold (2LAET) = 1 mg/kg.

10. U = Compound analyzed, but not detected above detection limit.

11. J = Estimated value.

12. UJ = Compound analyzed, but not detected above estimated detection limit.

Q:\Jobs\080224-01_JorgensenMaps\BODR\Total_PCBs_Subsurface_JVE.mxd nkochie 6/21/2013 12:43:20 PM

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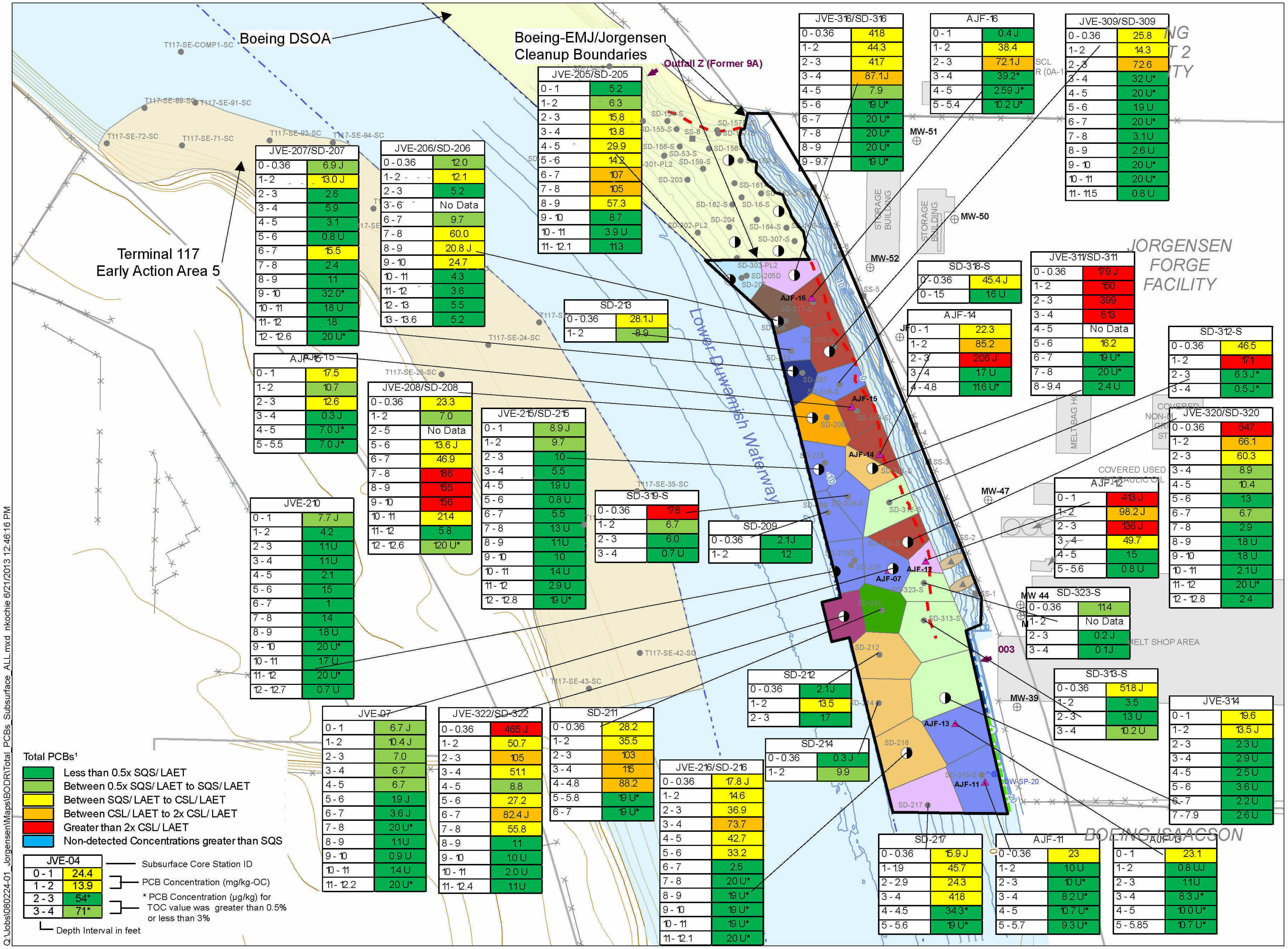
Feet

0 50 100 150 200

Figure 6

Subsurface Total PCB Concentrations at Additional Design Sampling Locations
Basis of Design Report
Jorgensen Forge Early Action Area



LEGEND

- Vertical Extent Sampling Location (Anchor, 2011)
- Subsurface Samples (Anchor, 2005)
- Subsurface Sampling Locations (others)
- Shoreline (0-2 ft) Bank Samples (Farallon, 2004)
- Debris Pile Samples (Farallon, 2004)
- Seep Sampling Location (Windward, 2004b)
- Groundwater Monitoring Well
- Active Outfall
- Concrete Panel Wall
- Toe of Riprap
- Sheetpile Wall
- Fences
- Federal Channel
- Removal Action Boundary
- Debris Pile
- Property Boundaries
- Boeing DSOA
- Terminal 117 Early Action Area 5 Boundary

Thiessen Polygon Depth of Contamination[2]

- 1 ft below mudline
- 2 ft below mudline
- 3 ft below mudline
- 4 ft below mudline
- 5 ft below mudline
- 6 ft below mudline
- 7 ft below mudline
- 8 ft below mudline
- 9 ft below mudline
- 10 ft below mudline
- 11 ft below mudline

NOTES:

1. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
*TOC value was <0.5% or > 3%; reported in µg/kg dry weight.
2. The depth of contamination was determined based on exceedances of the Total PCB Removal Action Level (RvAL), which EPA identified as the SQS concentration.
3. Bathymetric survey by eTrac dated February 8, 2012. Additional back survey by AEC Consultants, Inc. dated February 21, 2012. Bathymetric and bank survey merged with upland survey by PLS, Inc. dated January 24, 2012.
4. Outfall locations field identified on May 14, 2003.
5. The toe of riprap slope was surveyed during a low tide on August 28, 2008.
6. The Boeing-EMJ/Jorgensen cleanup boundaries are identified in the Memorandum of Understanding between Boeing and EMJ/Jorgensen Forge, dated August 2007 (EMJ et al. 2007).
7. Sediment Quality Standard (SQS) = 12 mg/kg-OC.
8. Lower Apparent Effects Threshold (LAET) = 0.13 mg/kg.
9. Cleanup Screening Level (CSL) = 65 mg/kg-OC.
10. Second Lower Apparent Effects Threshold (2LAET) = 1 mg/kg.
11. U = Compound analyzed, but not detected above detection limit.
12. J = Estimated value.
13. UJ = Compound analyzed, but not detected above estimated detection limit.

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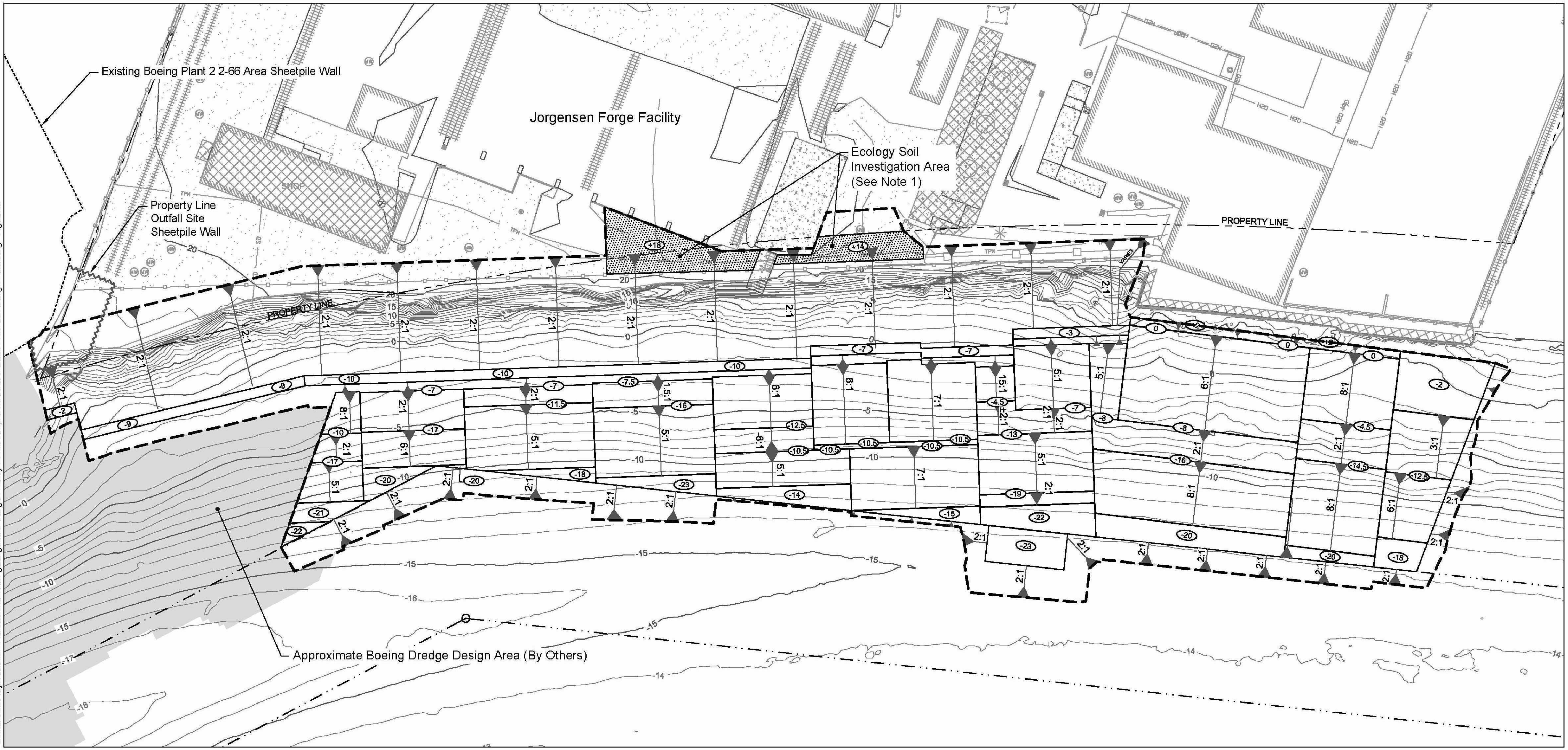
ANCHOR QEA

Feet
0 50 100 150 200

Figure 7
Subsurface Total PCB Concentrations & Depth of Contamination
Basis of Design Report
Jorgensen Forge Early Action Area



HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:

1. Jorgensen Forge is removing additional soil and backfilling along the top of bank area surrounding soil borings SB-3 and SB-4 to remove relatively elevated concentrations of polychlorinated biphenyls. This work is not being performed under the EPA scope of work but rather as an Independent Action under the existing Ecology Agreed Order (No. DE 4127) at the facility.

LEGEND:

- Navigation Channel
- Existing Bathymetry (1 ft interval)
- Existing Fence Line
- Required Dredge Elevation (ft MLLW)
- Top of Side Slope
- Final Grade
- Dredge Boundary
- Dredge/Excavation Limits
- Slope Arrow
- Structures to Preserve and Protect Adjacent to Dredge/Excavation Limits

0 50
Scale in Feet

\\Galaxy\cad\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Dredge Plan.dwg Figure 8
Mar 22, 2013 11:56am tgriga

ANCHOR QEA

Figure 8
Dredge Plan
Basis of Design Report
Jorgensen Forge Early Action Area

EMJ014200

K:\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Thiessen.dwg Figure 9a

Jun 07, 2013 3:47pm tgriga

HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTE: Existing Topography created from a merge of survey data by Anchor QEA including upland survey by PLS Inc. (1/24/12), bathymetric survey by eTrac (2/8/12), bank survey by AEC Consultants Inc (2/21/12), and additional bank survey by Duane Hartman & Associates, Inc. (10/25/20).

* Depth of contamination based on PCB exceedances of the removal action level (12 mg/kg-OC)

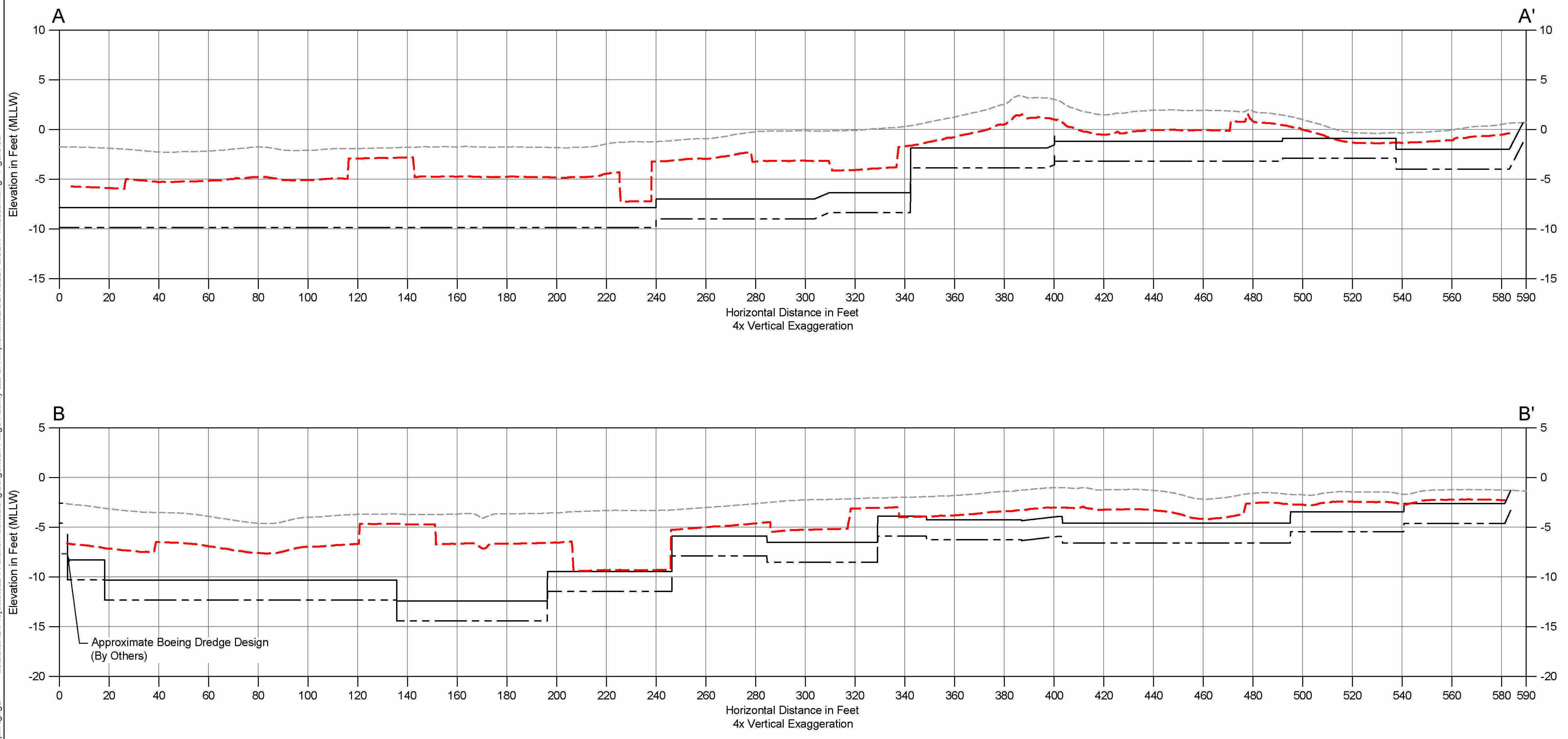
LEGEND:

- Navigation Channel
- Existing Bathymetry (1 ft interval)
- Existing Fence Line
- -13 Required Dredge Elevation (ft MLLW)
- Top of Side Slope
- Final Grade
- -17.5 Dredge Boundary
- Dredge/Excavation Limits
- Slope Arrow
- Structures to Preserve and Protect Adjacent to Dredge/Excavation Limits
- JVE-322 Subsurface Sampling Location

0 50
Scale in Feet

ANCHOR QEA

Figure 9a
Thiessen Polygon Minimum Removal Depths
Basis of Design Report
Jorgensen Forge Early Action Area

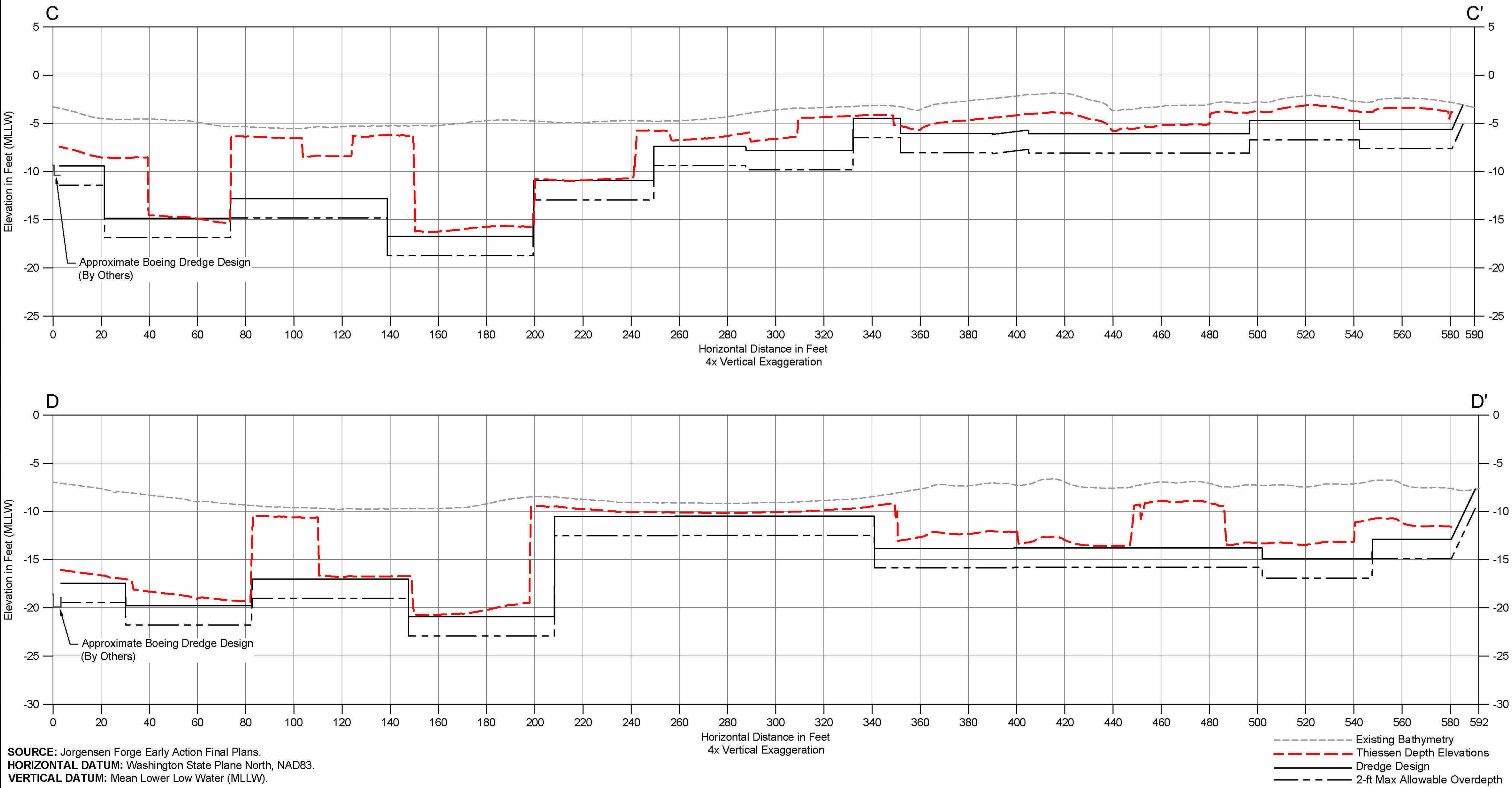


Existing Bathymetry
Thiessen Depth Elevations
Dredge Design
2-ft Max Allowable Overdepth

SOURCE: Jorgensen Forge Early Action Final Plans.
HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

ANCHOR QEA

Figure 9b
Dredge Design Surface and Thiessen Removal Depth Cross Sections
Basis of Design Report
Jorgensen Forge Early Action Area

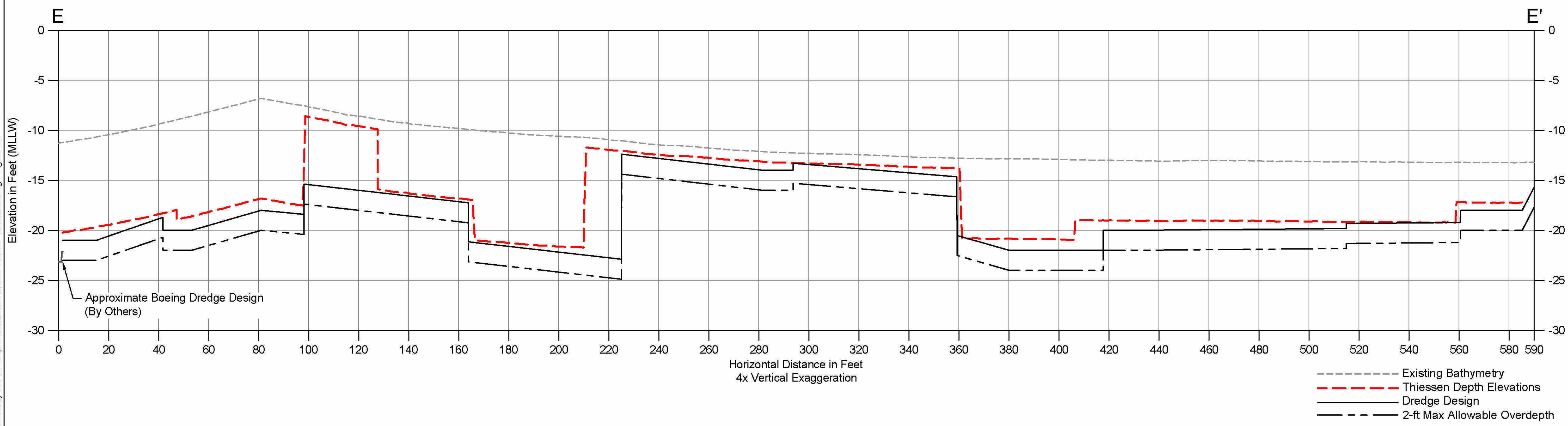


SOURCE: Jorgensen Forge Early Action Final Plans.
HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

\\Gaia\CAD\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Thiessen.dwg Figure 9c
Mar 22, 2013 12:03pm tgriga

ANCHOR QEA

Figure 9c
Dredge Design Surface and Thiessen Removal Depth Cross Sections
Basis of Design Report
Jorgensen Forge Early Action Area



SOURCE: Jorgensen Forge Early Action Final Plans.
HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

Mar 22, 2013 12:03pm tgriga \\Gala\CAD\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Thiessen.dwg Figure 9d

Figure 9d
Dredge Design Surface and Thiessen Removal Depth Cross Sections
Basis of Design Report
Jorgensen Forge Early Action Area

EMJ014204

Mar 22, 2013 12:04pm tgriga \\Gala\cad\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\BODR\0224-BODR-Stormwater.dwg Figure 10

ANCHOR QEA

Figure 10
Outfall Relocation Plan
Basis of Design Report
Jorgensen Forge Early Action Area

EMJ014205